



Durham E-Theses

Development and Implementation of the Interactive Electronic Lecture System as an Innovative Solution to Enhance Communication Skills

AL-THOBAITI, AHMED,RADAH,M

How to cite:

AL-THOBAITI, AHMED,RADAH,M (2015) *Development and Implementation of the Interactive Electronic Lecture System as an Innovative Solution to Enhance Communication Skills*, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/11170/>

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full Durham E-Theses policy](#) for further details.



Development and Implementation of the Interactive
Electronic Lecture System (IELS) as an Innovative Solution
to Enhance Lecturing and Communication Skills at King
Abdulaziz University

By

AHMED ALTHOBAITI

2015

PhD Thesis

SUPERVISOR: PROFESSOR MALCOLM MUNRO
SCHOOL OF ENGINEERING AND COMPUTER SCIENCES
TECHNOLOGY ENHANCED LEARNING
DURHAM UNIVERSITY DURHAM
UNITED KINGDOM

ABSTRACT

Research context: Communication and effective information exchange within technology has become a crucial part of delivering knowledge to students during the learning process. It enables better understanding, builds trust and respect, and increases the sharing of knowledge between students. Therefore interactivity is an important technology that has underpinned the learning process in recent years.

Research Aim: The primary purpose of this research is to investigate the effectiveness of applying a new lecturing system to the learning process and to examine its impact on the communication process.

Research Project: An interactive electronic lecture system (IELS) has been designed and developed. The IELS is a combination of a number of tools such as a recorded lecture divided into short clips, interactive interfaces, and interactive actions that enable students to engage with the lecture content. This system was created according to constructivism and connectivism learning theories. In order to build this system the ADDIE model was followed.

Research Method: A qualitative and quantitative empirical study has been applied. Two studies were conducted: a preliminary study to explore the current situation and check the feasibility of designing and developing a new lecturing system; a main study to examine and evaluate the effectiveness of applying a new lecturing system against the e-lecture. Two cohorts of participants from two departments were involved in this experiment; undergraduate students and lecturers. Six main dimensions (accessibility, usability, interactivity, learnability, communication and satisfaction) were analysed to check the impact of the new system. Students learning outcomes, exchange of information and students interaction with lecture content are three issues that have been discussed to compare between and show the differences between the e-lecture and IELS.

Research Result: The preliminary study found that it is feasible to develop and establish an interactive electronic lecture application to support and enhance the learning and lecturing process. It also found that such an interactive application would improve the learning process and achieve greater communication between students as well as between students and their lecturers. It would also offer a high level of interaction between students and the content of lectures. The main study found that the IELS has a positive effect on students' experiences regarding all variables and that there is a strong and positive relationship between all dimensions and satisfaction.

RESEARCH TERMS

Traditional lecture: A lecture attended by students in class and presented by the lecturer without any technology or equipment.

E-lecture: A traditional lecture attended by students in class, which the lecturer presents with the use of PowerPoint slides.

KAU: King Abdulaziz University, which is the main sponsor for this research and the location where this experiment was conducted.

IELS: Interactive electronic lecture system (IELS), which is an interactive web application that has been created to modify the lecturing system.

Preliminary study: The initial study conducted to explore the current situation and check the feasibility of applying a new lecturing system.

Popup action: Is an interactive technique which presents an interactive question that appears randomly when the video clip is running.

Click action: Is another interactive technique that requires the student to click on the mouse in the relevant place when he/she hears certain information about something; it appears for a limited time then disappears in order to motivate students to find the right answer.

Accessibility: Indicates some IELS system features such as: easy to register with the system, easy to sign in, easy to sign out, easy to run and easy to access to system contents.

Usability: indicates some IELS system features such as: easy to use, easy to edit personal settings, easy to view module, easy to view lecture, easy to view video clips, easy to view credits and easy to navigate.

Interactivity: indicates some IELS system features such as: interact with lecture content, actions enhance the interactivity of user and IELS fosters user ability to use.

Learnability: indicates some IELS system features such as: easy to learn from, actions easy to learn from, offers learning any time, facilitates learning process, and offers learning more than the e-lecture.

Communication: Indicates some IELS system features such as: easy to communicate with other users, easy to get feedback, easy to send message and easy to chat with users.

Satisfaction: Indicates satisfactory of users about of general IELS system features such as: dividing lecture into clips, clip time duration, lecture format, IELS interface designs, IELS interface colours, IELS multimedia, IELS operation, IELS speed.

DEDICATION

To the greatest lady in my life, my mother, Fatimah Althobaiti

To My wife and my children: Amal, Anas, Eenas, Sawsan and Nada

To all my brothers and sisters

To every one looking for knowledge

Ahmed Althobaiti



Acknowledgements



First, praise belongs to Almighty Allah and I give sincere thanks to Him, because He guided and helped me to complete this thesis; without His mercy and bounty this thesis would never have been accomplished.

I wish to express my immense gratitude to my mother for her continual support, encouragement, love, prayers for my progress and for teaching me the values in life that brought me where I am today. I am grateful to my sisters and brothers for their emotional and moral support.



I would like to acknowledge King Abdulaziz University, represented by the Saudi Cultural Bureau, who granted me the scholarship to complete my PhD, supported me during the period of conducting this thesis and helped me to publish a number of papers.



I would like to express my most sincere gratitude to my supervisor, Professor Malcolm Munro, for his commitment, constant support and intellectual guidance in helping me to make this dream a reality. He was a great supervisor who kept me focussed and made useful and wise suggestions and comments. I will not forget his words when I met him for the first time.

I also express my thanks to my previous supervisor, Professor Liz Burd, who supported me during the first year. I wish her a good life and success with her new job in Australia.

I would like to acknowledge and thank my friends, colleagues and participants, in Saudi Arabia in particular, who spent time working with me to evaluate this project. I thank them for their invaluable help and support during the research process, and for giving their time and sharing their views and experience with me. They will not be forgotten.



I would like to thank Durham University for harnessing all facilities, sources and equipment to create a suitable environment to complete this thesis.

Last, but by no means least, to my lovely wife and my dear children, Amal, Anas, Eenas, Sawsan and Nada. A big thank you for your support, help and patience. Without you I could not have completed this thesis.

Copyright © Ahmed Althobaiti 2015 The copyright of this thesis rests with the author. No quotation from this thesis should be published without prior written consent. Information derived from this thesis should also be acknowledged.

Declaration No part of the material provided has previously been submitted by the author for a higher degree in Durham University or in any other University. All the work presented here is the sole work of the author and no one else. The following publications were produced during the course of this thesis:

Online Journals

- 1- Althobaiti, A. & Munro, M. (2014) [Interactive Electronic Lecture System Design](#). *International Journal of Engineering Research and Technology* (IJERT) ISSN: 2278-0181. 732-736 Vol.3 Issue 7 , 2014
- 2- Althobaiti, A. & Munro, M. (2015) [Evaluating an Interactive Electronic Lecture System](#), *International Journal of Information and Education Technology* (IJET) ISSN: 2010-3689 vol. 5, no. 12, pp. 914-919, 2015
- 3- Althobaiti, A. & Munro, M. (2014) [Comparison Study of Learning Using the Traditional Lecture and the IELTS](#). *International Journal of e-Education, e-Business, e-Management and e-Learning* (IJEEEE) ISSN: 2010-3654 vo. 4, no. 5, pp. 341-350, 2014.
- 4- Althobaiti, A. & Munro, M. (2014), [Comparison of the Effectiveness of Communication between the Traditional Lecture and IELTS](#), World Academy of Science, Engineering and Technology, International Science Index 95, *International Journal of Social, Management, Economics and Business Engineering*, 8(11), 3214 - 3218.

Conferences

- 1- Althobaiti, A. & Munro, M. (2014) [An Interactive Electronic Lecture System](#). 2nd International Conference on Emerging Trends of E-Learning & Online Education Technology (ICETEOET 2014)- Munich- Germany, 2014
- 2- Althobaiti, A. & Munro, M. (2014) [Evaluating an Interactive Electronic Lecture System](#). The 3rd International Conference on Advancements in Information Technology (ICAIT 2014), 2014, Dubai, UAE
- 3- Althobaiti, A. & Munro, M. (2014) [Comparison Study of Learning Using the Traditional Lecture and the IELTS](#). *The 5th International Conference on Distance Learning and Education (ICDLE), 2014, Geneva, Switzerland*
- 4- Althobaiti, A. & Munro, M. (2014) [Preliminary Study of Interactive Electronic Lecture System](#). *The International Conference for Technology and Science London University ,2014 London, UK*
- 5- Althobaiti, A. & Munro, M. (2014) [Comparison of the Effectiveness of Communication between the Traditional Lecture](#) *International Conference on Knowledge and Software Engineering (ICKSE 2014) 2014 London, UK*
- 6- Althobaiti, A. & Munro, M. (2015) [Interactive Electronic Lecture System Design](#). *The 8th Saudi Student Conference 2015 Imperial College London, United Kingdom*
- 7- Althobaiti, A. & Munro, M. (2015) [Enhancement of Interactivity using a new lecturing system \(IELS\)](#) *Science and Information Conference 2015 July 28-30, 2015 | London, UK*

TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	Introduction.....	1
1.2	Context and Purpose of the Research	1
1.3	Criteria for Success	2
1.4	Outline of the Thesis Structure	4
2	LITERATURE REVIEW.....	7
2.1	Introduction.....	7
2.2	Learning	7
2.2.1	Importance of Learning.....	7
2.1.2	Definition of Learning	8
2.2.2	Learning Theories	9
2.1.3.1	Behaviourism theories.....	9
2.2.2.1	Cognitivism theories	10
2.2.2.2	Constructivism theory	11
2.2.2.3	Connectivism theory	12
2.2.3	Learning Styles	12
2.2.3.1	Experiential learning theory.....	13
2.2.3.2	Multiple intelligences theory	13
2.1.5	Factors of Learning	15
2.2.3.3	Maturation.....	15
2.2.3.4	Readiness	15
2.2.3.5	Motivation.....	15
2.2.3.6	Experience	16
2.2.4	Measuring Learning	16
2.2.5	Learning Design.....	16
2.2.5.1	Analysis	18
2.2.5.2	Design	19
2.2.5.3	Development.....	19
2.2.5.4	Implementation	19
2.2.5.5	Evaluation	20
2.3	Technology	20
2.3.1	Definition of Technology.....	20
2.3.2	Importance of Technology	21
2.3.3	Technology-enhanced Learning.....	22

2.4	Accessibility.....	24
2.5	Usability.....	25
2.6	Interactivity.....	27
2.6.1	Introduction.....	27
2.6.2	Definition of Interactivity.....	27
2.6.3	Human-Computer Interaction.....	28
2.6.4	Multimedia.....	29
2.6.4.1	Types of multimedia.....	29
2.6.4.2	Multimedia applications.....	30
2.6.5	Interactive E-learning.....	30
2.6.6	Interactive Lecture.....	31
2.6.6.1	Related work.....	32
2.7	Communication.....	37
2.7.1	Introduction.....	37
2.7.2	Definition of Communication.....	37
2.7.3	Communication Elements.....	38
2.8	Satisfaction.....	39
2.9	Conclusion.....	40
3	RESEARCH METHOD.....	41
3.1	Introduction.....	41
3.2	Background.....	41
3.3	Study Design.....	42
3.3.1	Design Techniques.....	43
3.3.1.1	Within-subjects design.....	44
3.3.1.2	Between-groups design.....	45
3.3.2	Variables.....	46
3.3.2.1	Independent variables.....	47
3.3.2.2	Dependent variables.....	47
3.3.3	IELS Functions and Attributes.....	49
3.3.3.1	IELS accessibility.....	50
3.3.3.2	IELS usability.....	50
3.3.3.3	IELS interactivity.....	50
3.3.3.4	IELS learnability.....	51
3.3.3.5	IELS communication.....	51
3.3.3.6	IELS satisfaction.....	52

3.3.4	Null Hypotheses.....	52
3.4	Data Analysis Methods.....	55
3.5	Data Collection.....	56
3.5.1	Preliminary Study.....	56
3.5.2	Main Study.....	57
3.5.2.1	Questionnaire.....	57
3.5.2.2	Participants.....	57
3.6	Analysis Framework.....	58
3.6.1	Shapiro-Wilk Test.....	59
3.6.2	Independent T-test / One Way ANOVA.....	60
3.6.3	Mann-Whitney U Test / Kruskal-Wallis Test.....	60
3.6.4	Paired Sample T-test.....	60
3.6.5	Principal Component Analysis.....	60
3.6.6	Cronbach's Alpha Test.....	61
3.6.7	Demographic Data Analysis.....	62
3.7	Experiment Protocol.....	63
3.8	Research Ethics.....	65
3.9	Threats to Validity.....	66
3.10	Conclusion.....	66
4	PRELIMINARY STUDY.....	67
4.1	Introduction.....	67
4.2	Preliminary Study Terms.....	67
4.3	Research Questions.....	68
4.4	Method.....	68
4.4.1	Participants.....	69
4.4.1.1	Students.....	69
4.4.1.2	Lecturers.....	70
4.4.2	Questionnaires.....	71
4.5	Results Analysis.....	71
4.5.1	Results Extracted from Form PQ1.....	71
4.5.2	Results Extracted from Form PQ2.....	76
4.5.3	Results Extracted from Open Questions.....	81
4.6	Discussion.....	84
4.7	Conclusion.....	85
5	INTERACTIVE ELECTRONIC LECTURE SYSTEM.....	86

5.1	Introduction.....	86
5.2	IELS Learning Theories.....	86
5.3	IELS Users.....	87
5.3.1	IELS Administrator.....	87
5.3.2	IELS Lecturer.....	87
5.3.3	IELS Student.....	88
5.4	IELS Application Specification.....	88
5.4.1	Accessibility.....	89
5.4.2	Usability.....	90
5.4.3	Learnability.....	91
5.4.4	Communication.....	91
5.4.5	Interactivity.....	93
5.4.5.1	Popup action.....	93
5.4.5.2	Click action.....	94
5.4.6	User Satisfaction.....	95
5.5	User Interfaces and Functionality.....	95
5.5.1	Administrator Account.....	96
5.5.2	Lecturer Account.....	96
5.5.3	Student Account.....	98
5.6	Conclusion.....	99
6	IELS IMPLEMENTATION.....	100
6.1	Introduction.....	100
6.2	IELS Requirements.....	100
6.2.1	IELS Design (ADDIE Model).....	101
6.2.1.1	Analysis.....	102
6.2.1.2	Design.....	103
6.2.1.3	Implementation.....	104
6.2.1.4	Development (high level IELS).....	107
6.2.1.5	Evaluation.....	115
	<i>Summative evaluation</i>	115
6.3	User Training.....	116
6.4	Conclusion.....	116
7	MAIN STUDY (DATA ANALYSIS AND RESULTS).....	117
7.1	Introduction.....	117
7.2	Quantitative Analysis.....	117

7.2.1	Analysis of IT Student groups	118
7.2.1.1	IELS accessibility analysis	118
7.2.1.2	IELS usability analysis	121
7.2.1.3	IELS interactivity analysis.....	125
7.2.1.4	IELS learnability analysis.....	127
7.2.1.5	IELS communication analysis	130
7.2.1.6	IELS satisfaction analysis.....	133
7.2.2	Analysis of Education Student Groups	138
7.2.2.1	IELS accessibility analysis	138
7.2.2.2	IELS usability analysis	140
7.2.2.3	IELS interactivity analysis.....	143
7.2.2.4	IELS learnability analysis.....	145
7.2.2.5	IELS communication analysis	148
7.2.2.6	IELS satisfaction analysis.....	150
7.2.3	Analysis of IT and Education Student groups	154
7.2.3.1	IELS accessibility analysis	154
7.2.3.2	IELS usability analysis	156
7.2.3.3	IELS learnability analysis.....	158
7.2.3.4	IELS interactivity analysis.....	161
7.2.3.5	IELS communication analysis	163
7.2.3.6	IELS Satisfaction Analysis	165
7.2.4	Analysis of the IT and Education Lecturer Groups	169
7.3	Analysis of Learning Outcomes.....	174
7.3.1	Analysis of the Results of the IT Groups.....	174
7.3.1.1	Analysis of the pre-test between e-lecture and IELS	174
7.3.1.2	Analysis of post-test between e-lecture and IELS	175
7.3.1.3	Comparison between pre-test and post-test for the IELS group	176
7.3.2	Analysis of the Results of the Education Groups	177
7.3.2.1	Analysis of the pre-test between the e-lecture and the IELS	177
7.3.2.2	Analysis of post-test for e-lecture and IELS.....	177
7.3.2.3	Comparison between the pre-test and post-test for the IELS group	178
7.4	Analysis of Exchange of Information between the IELS Groups.....	179
7.4.1	Analysis of Exchange of Information between IT Student Groups.....	179
7.4.1.1	Analysis of sent messages.....	180
7.4.1.2	Analysis of sent chat	181
7.4.1.3	Analysis of exchange of information between e-lecture and the IELS student groups	183

7.4.2	Analysis of Exchange of Information between Education Student Groups	184
7.4.2.1	Analysis of sent messages.....	184
7.4.2.2	Analysis of sent chat	185
7.4.2.3	Analysis of exchange of information between the e-lecture and the IELTS for Education student groups	187
7.5	Analysis of Students' Interaction with Lecture Content.....	188
7.5.1	Analysis of IT Student Groups' Interaction.....	188
7.5.2	Analysis of Education Student Groups' Interaction	189
7.6	Qualitative Analysis.....	190
7.6.1	Analysis of Students' Responses	190
7.6.2	Analysis of Lecturers' Responses.....	192
7.6.3	Discussion	193
7.7	Conclusion	194
8	DISCUSSION AND EVALUATION	195
8.1	Introduction.....	195
8.2	Preliminary Study	195
8.3	Evaluation of the IELTS.....	197
8.3.1	Accessibility.....	198
8.3.1.1	Previous studies vs IELTS	198
8.3.1.2	Factor analysis	198
8.3.1.3	Overall accessibility result.....	199
8.3.2	Usability.....	199
8.3.2.1	Previous studies vs IELTS	199
8.3.2.2	Factor analysis	200
8.3.2.3	Overall result for usability	201
8.3.3	Interactivity	201
8.3.3.1	Previous studies vs IELTS	201
8.3.3.2	Factor analysis	202
8.3.3.3	Overall interactivity result	202
8.3.4	Learnability.....	203
8.3.4.1	Previous studies vs IELTS	203
8.3.4.2	Factor analysis	204
8.3.4.3	Overall learnability result	204
8.3.5	Communication.....	205
8.3.5.1	Previous studies vs IELTS	205
8.3.5.2	Factor analysis	205

8.3.5.3	Overall communication result.....	206
8.3.6	Satisfaction.....	206
8.3.6.1	Previous studies vs IELTS	206
8.3.6.2	Factor analysis	207
8.3.6.3	Overall satisfaction result	208
8.3.7	Learning outcomes.....	208
8.3.8	Exchange information.....	209
	Exchange.....	209
	Information	209
8.3.9	Interaction with the lecture content.....	209
8.4	Null Hypotheses Testing.....	210
8.5	Answer to Research Questions (Q5-Q13).....	214
8.6	Correlation between IELTS Variables	216
8.7	Evaluation of IELTS Implementation	217
8.8	Comparison between IELTS and Previous Studies.....	218
8.9	Conclusion	222
9	CONCLUSION AND FUTURE WORK	223
9.1	Introduction.....	223
9.2	Summary of Experiment.....	223
9.3	Summary of Research Findings	224
9.4	Research Contribution	226
9.5	Criteria for Success	228
1-	Identify critical factor for creating and developing IELTS	228
2-	Provide guidelines for designing and developing IELTS	228
3-	Analyse the participants' responses in the main study	229
4-	Evaluate the efficiency of applying the IELTS	230
5-	Compare the IELTS and the e-lecture	232
6-	Provide an innovative solution for lecturing in a novel format against the previous studies	234
9.6	Research Limitations	235
9.7	Future Work and Recommendations	236
9.8	Conclusion	237
	APPENDIX A.....	238
	APPENDIX B.....	243

APPENDIX C.....	247
APPENDIX D.....	252
APPENDIX E.....	271
REFERENCES	279

LIST OF TABLES

Table 2-1 : Summary of previous studies' results	36
Table 3-1 : Reliability test for Questionnaires (MQ1).....	61
Table 3-2 : Reliability test for Questionnaires (MQ2).....	61
Table 3-3 : Students' demographic (PQ1)	62
Table 3-4 : Students' demographics (MQ1)	62
Table 3-5 : Lecturers' demographic questionnaire (PQ2)	62
Table 3-6 : Lecturer demographic (MQ2)	63
Table 3-7 : Number of students who participated in the experiment.....	63
Table 3-8 : Number of lecturers who participated in the experiment	63
Table 4-1 : Participants' status and gender	69
Table 4-2 : Students' university level	69
Table 4-3 : Students' GPA	69
Table 4-4 : Students' frequency according to department	70
Table 4-5 : Lecturers' years of experience	70
Table 4-6 : Lecturers' competency in computer skills.....	70
Table 4-7 : Lecturers' departments	71
Table 4-8 : Students' internet usage for learning	72
Table 4-9 : Frequency of students' area of focus.....	72
Table 4-10 : Frequency of type of lecture delivered in students' colleges	73
Table 4-11 : Frequency of colleges who deliver lectures on their websites	73
Table 4-12 : Frequency of type of lecture delivered in college website	74
Table 4-13 : Frequency of students interested in seeing lectures online	74
Table 4-14 : Frequency of students' preference of lecture type	74
Table 4-15 : Frequency of type of interactive lecture preferred	75
Table 4-16 : Frequency regarding preference to interact with lecture	75
Table 4-17 : Frequency of students' interest in learning via internet app	75
Table 4-18 : Frequency of students' online communication	76
Table 4-19 : Frequency of lecturers' communication with students.....	76
Table 4-20 : Frequency of focus when using college website	77
Table 4-21 : Frequency of type of lectures delivered	77
Table 4-22 : Frequency of colleges delivering lectures on their websites	78

Table 4-23 : Frequency of type of lecture viewed on website	78
Table 4-24 : Frequency of students allowed to view lectures online.....	78
Table 4-25 : Frequency of how interested lecturers are in delivering interactive lectures	79
Table 4-26 : Frequency of suitable way of lecturing	79
Table 4-27 : Frequency of need to create interactive electronic lectures	79
Table 4-28 : Frequency of whether IEL will affect students' performance.....	80
Table 4-29 : Frequency of type of interactive electronic lecture preferred	80
Table 4-30 : Frequency of students who would benefit from IEL.....	80
Table 4-31 : Reasons for delivering whole lecture or clips	82
Table 4-32 : Participants comments.....	83
Table 6-1 : IELS specification	101
Table 6-2 : IELS Main Entity	112
Table 6-3 Types of relationship between entities	112
Table 7-1 : Statements of Q5 and sub null hypotheses (IT groups).....	118
Table 7-2 : Normality distribution test for IELS accessibility (IT groups)	119
Table 7-3 : Means of accessibility for student groups Popup and Click (IT groups)	120
Table 7-4 : Independent sample t-test for IELS accessibility (IT groups).....	120
Table 7-5 : Sub null hypothesis test result for IELS accessibility (IT groups).....	121
Table 7-6 : Statements of Q6 and sub null hypotheses (IT groups).....	122
Table 7-7: Normality distribution test for IELS usability (IT groups)	123
Table 7-8 : Means of IELS usability of student groups B1 and B2 (IT groups).....	124
Table 7-9 : Independent sample t-test For IELS usability (IT groups).....	124
Table 7-10 : Sub null hypotheses test result for IELS usability (IT groups)	125
Table 7-11 : Statements of Q7 and sub null hypotheses (IT groups).....	125
Table 7-12 : Normality distribution test for IELS interactivity (IT groups).....	126
Table 7-13 : Means of IELS interactivity of student groups B1 and B2 (IT groups)	127
Table 7-14 : Independent sample t-test for IELS interactivity (IT groups)	127
Table 7-15 : Sub null hypotheses test result for IELS interactivity (IT groups).....	127
Table 7-16 : Statements of Q8 and null hypotheses (IT groups)	128
Table 7-17 : Normality distribution for IELS learnability (IT groups)	128
Table 7-18 : Means of learnability of student groups B1 and B2 (IT groups).....	129
Table 7-19 : Independent sample t-test for IELS learnability (IT groups)	130
Table 7-20 : Sub null hypotheses test result for IELS learnability (IT groups).....	130
Table 7-21 : Statements of Q9 and sub null hypotheses (IT groups).....	131

Table 7-22 : Normality of distribution test for IES communication (IT groups)	131
Table 7-23 : Means of communication for IT student groups	132
Table 7-24 : Independent sample t-test for IELTS communication (IT groups).....	133
Table 7-25 : Sub null hypotheses test result for IELTS communication (IT groups)	133
Table 7-26 : Statements of Q10 and sub null hypotheses (IT groups).....	134
Table 7-27 : Normality distribution test for IELTS satisfaction (IT groups).....	134
Table 7-28 : Means of satisfaction of IT student groups	136
Table 7-29 : Independent sample t-test for IELTS satisfaction.....	136
Table 7-30 : Mann-Whitney U test for IELTS satisfaction (IT groups)	136
Table 7-31 : Sub null hypotheses test result for IELTS satisfaction (IT groups).....	137
Table 7-32 : Statements of Q5 and sub null hypotheses (Education groups)	138
Table 7-33 : Normality distribution test for IELTS accessibility (Education groups).....	139
Table 7-34 : Means of accessibility for student groups C1 and C2 (Education groups)	139
Table 7-35 : Mann-Whitney U test for IELTS accessibility (Education groups)	140
Table 7-36 : Sub null hypotheses test result for IELTS accessibility (Education groups).....	140
Table 7-37 : Statements of Q6 and sub null hypotheses (Education groups)	141
Table 7-38 : Normality distribution test for IELTS usability (Education groups).....	141
Table 7-39 : Means of IELTS usability of student groups C1 and C2 (Education groups)	142
Table 7-40 : Mann-Whitney U test for IELTS usability (Education groups)	143
Table 7-41 : Sub null hypotheses test result for IELTS usability (Education groups).....	143
Table 7-42 : Statements of Q7 and sub null hypotheses (Education groups)	144
Table 7-43 : Normality distribution for IELTS interactivity (Education groups).....	144
Table 7-44 : Means of IELTS interactivity of student groups C1 and C2 (Education groups)	145
Table 7-45 : Mann-Whitney U test For IELTS interactivity (Education groups)	145
Table 7-46 : Sub null hypothesis test result for IELTS interactivity (Education groups).....	145
Table 7-47 : Statements of Q8 and null hypotheses (Education groups).....	146
Table 7-48 : Normality distribution for IELTS learnability (Education groups).....	146
Table 7-49 : Means of learnability of student groups C1 and C2 (Education groups)	147
Table 7-50 : Mann-Whitney U test for IELTS learnability (Education groups)	147
Table 7-51 : Sub null hypotheses test result for IELTS learnability (Education groups)	148
Table 7-52 : Statements of Q9 and null hypotheses (Education groups).....	148
Table 7-53 : Normality distribution test for IES communication (Education groups)	149
Table 7-54 : Means of communication of student groups C1 and C2 (Education groups) ...	149
Table 7-55 : Mann-Whitney U test for IELTS communication (Education groups)	150

Table 7-56 : Sub null hypotheses test result for IELTS communication (Education groups)..	150
Table 7-57 : Statements of Q10 and sub null hypotheses (Education groups)	151
Table 7-58 : Test for normality of distribution for IELTS satisfaction (Education groups)....	152
Table 7-59 : Means of satisfaction for student groups C1 and C2 (Education groups).....	152
Table 7-60 : Mann-Whitney U test for IELTS satisfaction (Education groups)	153
Table 7-61 : Sub null hypotheses test result (Education groups).....	153
Table 7-62 : Statements of Q5 and sub null hypotheses (IT and Education groups).....	154
Table 7-63 : Means of accessibility for IT and Education student groups	155
Table 7-64 : Mann-Whitney U test For IELTS accessibility (IT and Education Groups)	155
Table 7-65 : Sub null hypotheses test result for IELTS accessibility (IT & Education groups)	155
Table 7-66 : Statements of Q6 and sub null hypotheses (IT and Education groups).....	156
Table 7-67 : Means of IELTS usability of IT and Education Student groups)	157
Table 7-68 : Mann-Whitney U test for IELTS usability (IT and Education groups).....	157
Table 7-69 : Sub null hypotheses test result for IELTS usability (IT & Education groups)....	158
Table 7-70 : Statements of Q7 and null hypotheses (IT and Education groups).....	159
Table 7-71 : Normality distribution test for IELTS learnability (IT and Education).....	159
Table 7-72 : Means of learnability of experimental groups (IT and Education groups)	160
Table 7-73 : Mann-Whitney U test for IELTS learnability (IT and Education groups)	160
Table 7-74 : Sub null hypotheses test result for IELTS learnability (IT and Education groups)	161
Table 7-75 : Statements of Q8 and null hypotheses (IT and Education groups).....	161
Table 7-76 : Normality distribution test for IELTS interactivity (IT and Education groups)..	162
Table 7-77 : Means of IELTS interactivity of student groups (IT and Education groups)	162
Table 7-78 : Mann-Whitney U test for IELTS interactivity (IT and Education groups)	162
Table 7-79 : Sub null hypotheses test result for IELTS interactivity (IT and Education groups)	163
Table 7-80 : Statements of Q9 and null hypotheses (IT and Education groups).....	163
Table 7-81 : Normality of distribution test for IELTS communication (IT and Ed groups)....	164
Table 7-82 : Means of communication of student groups (IT and Education groups)	164
Table 7-83 : Mann-Whitney U test for IELTS communication (Education and IT groups)....	165
Table 7-84 : Sub null hypotheses test result for IELTS communication (IT and Education groups)	165
Table 7-85 : Statements of Q10 and null hypotheses (IT and Education groups).....	166

Table 7-86 : Normality distribution test for IELTS satisfaction (IT and Education groups)...	167
Table 7-87 : Means of satisfaction of student groups (IT and Education groups).....	167
Table 7-88 : Mann-Whitney U test for IELTS satisfaction (IT and Education groups)	168
Table 7-89 : Sub null hypotheses test result (IT and Education groups).....	169
Table 7-90 : Means of accessibility usability and interactivity	170
Table 7-91 : Means of learnability, communication and satisfaction.....	171
Table 7-92 : Mann-Whitney U test for accessibility, usability and interactivity.....	172
Table 7-93 : Mann-Whitney U test for learnability, communication and satisfaction	173
Table 7-94 : Null hypotheses test result for lecturer groups.....	174
Table 7-95 : Basic statistics for pre-test for IT student groups.....	174
Table 7-96 : Independent t test sample (pre-test IT student groups)	175
Table 7-97 : Basic statistics for post-test for IT student groups	175
Table 7-98 : Independent t test sample (post-test IT student groups).....	175
Table 7-99 : Null hypothesis NH11.1 test result.....	176
Table 7-100 : Basic statistics of pre-test and post-test for the IELTS group	176
Table 7-101 : Paired sample test (IELS group)	176
Table 7-102 : Basic statistics for pre-test for e-lecture and IELTS groups.....	177
Table 7-103 : Independent t-test sample (pre-test)	177
Table 7-104 : Basic statistics for post-test for IELTS groups	178
Table 7-105 : Independent t-test sample (post-test) Education groups.....	178
Table 7-106 : Null hypothesis NH11.2 test result.....	178
Table 7-107 : Basic statistics of pre-test and post-test for the IELTS group	179
Table 7-108 : Paired sample test (IELS group)	179
Table 7-109 : Sent mail per minute.....	180
Table 7-110 : Means of messages for the IT groups.....	180
Table 7-111 : Independent t-test sample messages for IT groups	181
Table 7-112 : Chats sent per minute (IT).....	181
Table 7-113 : Means of chat for IT groups	182
Table 7-114 : Independent t-test sample (sent chat per min) IT groups	182
Table 7-115 : Null hypothesis NH12.1 test result.....	182
Table 7-116 : Means of student exchange of information for IT groups.....	183
Table 7-117 : Independent t-test sample (exchange of information) for IT groups.....	183
Table 7-118 : Null hypothesis NH12.2 test result.....	183
Table 7-119 : Sent mail per minute.....	184

Table 7-120 : Mean of messages Education groups	185
Table 7-121 : Independent t-test sample of sent messages for Education groups	185
Table 7-122 : Chats sent per minute	186
Table 7-123 : Means of chat for Education groups.....	186
Table 7-124 : Independent t-test sample sent chat education groups	186
Table 7-125 : Null hypothesis NH12.3 test result.....	187
Table 7-126 : Means of students' exchange of information for Education groups	187
Table 7-127 : Independent t-test sample (exchange of information) for Education groups ..	187
Table 7-128 : Null hypothesis NH12.4 test result.....	188
Table 7-129 : Means of IT student groups' interaction	188
Table 7-130 : Independent t-test sample (students interaction) IT groups	189
Table 7-131 : Null hypothesis NH13.1 test result.....	189
Table 7-132 : Means of Education student groups' interaction.....	189
Table 7-133 : Independent t-test sample (students interaction) Education groups.....	190
Table 7-134 : Null hypothesis NH13.2 test result.....	190
Table 7-135 : Students' open question responses	192
Table 7-136 : Lecturers' open question responses.....	193
Table 8-1 : Answers to questions 1 - 4	197
Table 8-2 : Factor analysis result for accessibility.....	199
Table 8-3 : Overall accessibility result for the IELTS	199
Table 8-4 : Factor analysis result for usability of IELTS.....	200
Table 8-5 : Overall usability result of the IELTS.....	201
Table 8-6 : Factor analysis result for interactivity	202
Table 8-7 : Overall interactivity result for the IELTS.....	203
Table 8-8 : Factor analysis result for learnability	204
Table 8-9 : Overall learnability result for the IELTS	204
Table 8-10 : Factor analysis result for communication	206
Table 8-11 : Overall communication result for the IELTS	206
Table 8-12 : Factor analysis result for satisfaction	207
Table 8-13 : Overall satisfaction result of the IELTS	208
Table 8-14 : Overall post-test result of learning outcomes for all groups	209
Table 8-15 : Overall test result of exchange information for all groups.....	209
Table 8-16 : Overall test result of interaction with lecture content	210
Table 8-17 : Main null hypotheses (NH5-NH10) test result.....	212

Table 8-18: Main null hypotheses(NH11-NH13) test result.....	213
Table 8-19 : Research questions answers	215
Table 8-20 : Correlation coefficient between variables	217
Table 8-21 : Comparison between the IELTS and previous studies	221

LIST OF FIGURES

Figure 2-1 Research dimensions	7
Figure 2-2 : Application features	25
Figure 2-3 : Software quality characteristics	26
Figure 2-4 : The linear model of communication	38
Figure 2-5 : Osgood and Schramm communication model	39
Figure 2-6 : Chin and Lee's satisfaction model	40
Figure 3-1 : E- lecture	43
Figure 3-2 : IELTS lecture	43
Figure 3-3 : Within-subjects and between-groups designs	44
Figure 3-4 : Within-subjects design for both groups separately	45
Figure 3-5 : Between-groups design	46
Figure 3-6 : Independent and sub independent variables.....	47
Figure 3-7 : Dependent variables	48
Figure 3-8 : Measure Dependent variables	49
Figure 3-9: Analysis framework according to statistical SPSS tests	58
Figure 3-10 : Analysis framework according to research questions.....	59
Figure 3-11 : Experiment map	65
Figure 5-1 : Main components of IELTS	89
Figure 5-2 : IELTS attributes	89
Figure 5-3 : IELTS accessibility	90
Figure 5-4 : IELTS usability	90
Figure 5-5 : IELTS learnability	91
Figure 5-6 : IELTS communication elements	92
Figure 5-7 : The IELTS Actions.....	94
Figure 5-8 : IELTS Satisfaction	95
Figure 6-1 : ADDIE circle design	102
Figure 6-2 : IELTS storyboards.....	104
Figure 6-3 : Adobe Photoshop CS8.0 screen design.....	105
Figure 6-4 : Adobe Image Ready CS system logo design	106
Figure 6-5 : Adobe Dreamweaver system design	107
Figure 6-7 : Click action code.....	109

Figure 6-7 ER Digram for IELTS	112
Figure 6-8 : Transfer of IELTS files to the server.....	114
Figure 6-9 : Student credit and chat box	115
Figure 7-1: Normality distribution curve for item A1	119
Figure 7-2 : Normality distribution curve for item U2	122
Figure 7-3 : Normality distribution curve for item I3.....	126
Figure 7-4 : Normality distribution curve for item L5.....	129
Figure 7-5 : Normality distribution curve for item C2	132
Figure 7-6 : Normality distribution curve for item S5.....	135

1

Introduction

1.1 Introduction

There is a continuous need to make learning easier because it might help to achieve a great successful at all levels of academic during the learning process (Mujtaba and Preziosi, 2006). In the last ten years, Saudi Arabia has witnessed a revolution in both quality and quantity in the development of higher education (Borg and Alshumaimeri, 2012). The reason behind this expansion has been the increase in the number of students enrolling in Saudi universities, including those who are employed and require advanced training to help them in their current jobs, which has encouraged higher education institutions in Saudi Arabia to provide the option of distance learning (Borg and Alshumaimeri, 2012). According to the Saudi Ministry of Higher Education website, the number of public universities in the country increased from eight in 2000 to 25 in 2014, while nine private universities have also been established since 2000 (Higher Education, 2014). This has necessitated the development of e-learning in higher education, so as to endorse the interactive impartation of knowledge and skills to students. An analysis of the demands for access to support in e-learning systems in the context of higher education information services is imperative as it guarantees that better strategies are adopted to ensure interactive learning (Hunter, 2006). There is a close link between improvements in information technology and knowledge; they both lead to an increase or expansion in economic growth in a country (Johnes and Johnes, 2004). In the context of making the learning process easier, an interactive electronic lecture system has been designed and developed.

1.2 Context and Purpose of the Research

Despite the progress of higher education in Saudi Arabia, e-learning is still in its infancy, with a lack of a professional support base (Al-Harbi, 2011). The technology infrastructure is relatively good, but use of the infrastructure is poor as there are almost no instructional

designers. In order to ensure excellence in the impartation of knowledge to students, King Abdulaziz University (KAU) has adopted e-learning to develop and support the learning process (KAU, 2010). In view of this, KAU aims to become one of the best universities in the world in terms of the provision of quality education services, research and academic competence, with the development of its system and the implementation of e-learning (KAU, 2010).

In the context of using e-learning, a new model of lecturing in the form of the interactive electronic lecture system (IELS) will be designed and developed in order to enhance the learning and communication processes at KAU. An analysis of the goals, effectiveness and impacts of such a system at King Abdulaziz University will be conducted in this research to ascertain whether the IELS promotes students' performance, taking into consideration their needs. The proposed system should enable students to build trust and respect, foster learning and accomplish goals.

Two common types of lecture are delivered to undergraduate students at KAU, traditional lectures and e-lectures. The traditional lecture involves undergraduate students attending lectures in the class and listening to the lecturer. In this type of lecture no discussion or interaction is usually required and no technology or equipment is used. The e-lecture is delivered to students in the class via presentation (PowerPoint slides) and it aims to motivate students regarding the lecture topic.

1.3 Criteria for Success

The aim of the proposed research is to evaluate, examine, develop, then facilitate the delivery of lectures during the learning and communication process at KAU. The purpose of developing good lecturing for students is to make learning convenient and more interactive. The present research also attempts to investigate whether using the interactive electronic lecture system alongside e-lecturing is significantly different from lecturing with the e-lecture. It may create high-value education by supporting learning for all categories of students in various fields, and widening their personal and professional development. The goals of this research are to:

1- Identify critical factors for creating and developing IELS

This research will conduct a preliminary study to explore certain issues, and investigate the feasibility of creating and developing a system such as the interactive electronic lecture system for undergraduate students at KAU. Thus, some research questions will be investigated and taken into consideration, such as;

- Q1. What is the current situation regarding delivering lectures at KAU?
- Q2. What is the desired situation for delivering lectures at KAU?

2- Provide guidelines for designing and developing IELS

This research will provide guidelines to build an interactive electronic environment that will include certain types of multimedia, suitable for undergraduate students in higher education. To prepare a comprehensive guideline that will help to build the new system, two questions will be answered.

- Q3. What learning theory could be applied to the interactive electronic lecture system?
- Q4. What technologies might be used to enhance interactivity in the IELS?

3- Analyse the participants' responses in the main study

The main study will be conducted to carry out this research using a control group and an experimental group to check the proposed system. The participants will be chosen from different departments and they will be selected randomly.

4- Evaluate the efficiency of applying the IELS

Mixed methods (quantitative and qualitative) will be applied to analyse the data; this will also help to evaluate the efficacy of applying the IELS as a new lecturing system. Six dimensions will be evaluated: accessibility, usability, interactivity, learnability, communication and satisfaction. Therefore a number of questions have been formulated to evaluate these dimensions as follows:

- Q5. Does accessibility differ between the IELS groups?
- Q6. Does usability differ between the IELS groups?

- Q7. Does interactivity differ between the IELTS groups?
- Q8. Does learnability differ between the IELTS groups?
- Q9. Does communication differ between the IELTS groups?
- Q10. Does satisfaction differ between the IELTS groups?

5- Compare the IELTS with the e-lecture

An empirical study will be conducted to compare the IELTS and the e-lecture within the learning and communication process. Testing of the six previously stated research dimensions will help to evaluate the learning outcomes, student interaction with lecture content and exchange of information in a comparison between the e-lecture and the IELTS. In order to determine whether there is a significant difference between the populations, two groups will participate in this study, the control groups (A1 and A2) and the experimental groups (B1, B2 and C1 ,C2), and the following three questions will be asked.

- Q11. Do learning outcomes differ between the e-lecture groups and the IELTS groups?
- Q12. Does exchange of information differ between the e-lecture groups and the IELTS groups?
- Q13. Does student interaction with lecture content differ between the e-lecture groups and the IELTS groups?

6- Provide an innovative solution to lecturing in a novel format

The research will review some of the previous studies and critique them against the IELTS to establish the differences between them, and determine the contribution this thesis will make in the field of lecturing.

1.4 Outline of the Thesis Structure

This thesis contains nine chapters. A brief summary of their contents is as follows:

Chapter 1 (Introduction): Introduces the thesis and presents the context and the purpose of conducting this research. It also sets out the criteria for success, then outlines the

thesis chapters. This chapter highlights lecturing styles and identifies the research objectives, as well as explaining the context and the purpose of the research. Then it addresses the main research questions and identifies the research groups.

Chapter 2 (Literature Review): Investigates and reviews some main issues related to the thesis topic, namely: learning, technology, communication, interactivity, accessibility, usability, and satisfaction. It looks at many aspects of learning, such as the importance of learning, the definition of learning, learning styles, learning theories, learning factors, learning measurements and learning design. It also discusses a number of issues related to technology such as its definition, its importance and whether it enhances the learning and communication processes. It provides a definition of communication and its theory, and how it will improve the use of technology. Finally, it discusses certain aspects of interactivity, such as its definition, human/computer interaction, types of multimedia, interactive e-learning and interactive lecture, and then looks at some previous studies which have been conducted in this area.

Chapter 3 (Research Method): Discusses the methods employed in this research and research instruments are described. In addition, study design and approaches are discussed, design techniques analysed, and experiment procedures listed. It also illustrates how data is collected and presents how the framework is analysed. It determines the relationship between dependent and independent variables. Research questions are translated into null hypotheses to be evaluated. Data sources are described, and finally the threats to the validity of the research are addressed and research ethics are presented.

Chapter 4 (Preliminary Study): Investigates the feasibility of applying a system such as the IELS at King Abdulaziz University. It looks at the current situation for delivering lectures and expresses the desired situation. Questions Q1, Q2, Q3 and Q4 are addressed using mixed methods to answer them. Basic statistics approaches are analysed, participants' responses discussed and key ideas extracted from open questions.

Chapter 5 (IELS): Presents the notion behind creating the IELS and describes how the IELS helps to enhance the learning and communication process. It also shows what theories it is based on and what technology is developed to enhance the level of interaction between the system's users, what components are combined to form this system and what functions can

be delivered. Moreover, it identifies each user and specifies their roles when using the IELS. The system's features and specification are also described,

Chapter 6 (IELS Implementation): Describes how the IELS was implemented and what software and programs were utilised. It also discusses what learning design model was followed (ADDIE - Analyse, Design, Develop, Implement and Evaluate) and explains it step by step. Each step is explained in terms of the process of creating the IELS. System storyboards are drawn, and its interfaces are described. Some programming codes are shown and finally the uploading and running of the system are tested and user training considered.

Chapter 7 (Data Analysis): Quantitative and qualitative methods are applied to analyse data extracted in the main study from research instruments such as main questionnaires, post-tests, pre-tests, and system records. To check the distribution across the data and identify which test should be used a normality test is applied. For quantitative method, parametric and nonparametric tests are conducted to test the research null hypotheses and check the differences between experiment groups; these include the Basic statistic test, Independent t-test, Mann Whitney test, and Paired Sample test. All six main research dimensions are analysed. Qualitative method was applied to analyse and evaluate the participants' perspectives extracted from open questions.

Chapter 8 (Discussion and Evaluation): Discusses and evaluates all results obtained in Chapter 4 and Chapter 7. It evaluates, and provides a brief comparison between the IELS and previous studies of the six main dimensions. The overall result of evaluating the IELS dimensions is presented. In addition, it shows the results of the testing of the null hypotheses of the research, then answers all the research questions. In order to determine variances between each variable, factor analysis is applied. Finally, Spearman Correlation Coefficient is used to check the relationship across the research variables.

Chapter 9 (Conclusion and Future Work): Concludes the research results and summarises the experiment procedures to provide the research findings. In addition, the contribution this research is expected to make to the literature is addressed, and criteria for success evaluated. It discusses the limitations and the scope of this research. It then suggests future work with regards to the developing of the IELS or applying such an experiment. Finally it presents the recommendations.

2

Literature Review

2.1 Introduction

This chapter reviews the main dimensions that were identified as criteria for the success of the research in Chapter 1. Figure 2.1 shows the research dimensions. Learning, as a major dimension of this research, is also reviewed here. Many aspects of learning are considered in this review such as importance of learning, definition of learning, learning theories, learning styles, learning factors, measuring of learning, and its technology. It also reviews four previous studies that were conducted in the same area and provides a brief comparison between them to present their results and findings as shown in Table 2.1.

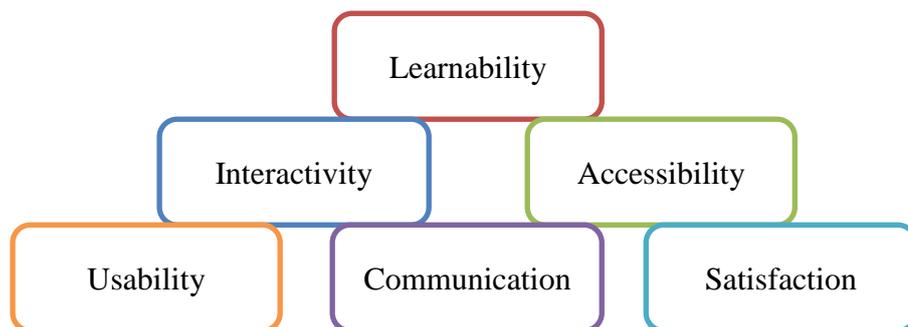


Figure 2-1 Research dimensions

2.2 Learning

2.2.1 Importance of Learning

In recent years there has been a crucial shift in the focus of learning in general, and e-learning for higher education in particular (Sharpe, 2005). Learning has become one of the most important individual processes in institutions, schools, and universities, and e-learning contains some features such as temporal flexibility, accessibility, interactivity and availability that may enhance the learning process (Casanova, Moreira and Costa, 2011).

Schunk (2012) states that learning involves acquiring or modifying knowledge, skills, strategies, beliefs, attitudes and behaviours. Pritchard (2013) asserts that learning is not exclusive to the domain of an education system, but it begins long before formal education and continues for even longer afterwards; it takes place rapidly, and in parallel with formal schooling, in a great number of different ways and settings. To conclude, learning is a major component in our daily life.

2.1.2 Definition of Learning

The learning process is a crucial part of the cognitive processes. Although most people would agree that education is crucial, they may have different opinions on the causes, processes, and consequences of learning (Schank, 1995). It is necessary here to define learning as a process, rather than to attempt to present a history of learning.

There is no one definition of learning; rather there are many definitions. For example, Burns (1995) perceives learning as a comparatively permanent modification in behaviour which includes both observable activity and internal processes such as thinking, attitudes and emotions. Ahmad (2008) defines it as a relatively permanent change in one's attitude or behaviour that occurs as a result of repeated experience. According to Carnell *et al.* (2005) learning is a reflective activity which allows the learner to draw upon previous experiences to perceive and evaluate the present, and thus to inform future actions and thereby formulate new knowledge. Also, learning is something which involves change, and occurs over time through experience (O'Donnell, Reeve and Smith, 2011). Another definition, similar to the previous one is that learning is a long-term change in mental representations or associations as a result of experience (Ormrod, 2011). Furthermore Pritchard (2013) observes that learning is something of which people all have an understanding and in which they have all participated.

Focusing on the learner as a main element within the learning process, learning is not just an act, but it is a process of conveying experiences and information toward applied behaviours, skills, attitudes and knowledge (Kwan, 2011).

2.2.2 Learning Theories

The pedagogy and sciences include a wide range of theories that offer explanations and clarifications of the phenomena or events on which those theories might be applied.

There are a number of diverse theories regarding how people learn. Learning theories can be considered as organised attempts to generate knowledge about human behaviour in order to explain a behavioural and unpredictable phenomenon (McConnell and Philipchalk, 1992). Of course the main objective of learning theories is to understand human behaviour in terms of how behaviour is formed and to identify the variables and causes of behaviour (Stein and Cutler, 2002).

It is useful to ponder the application of theories in order to determine how students learn and additionally how they are taught. This leads to the suggestion that teaching activities and learning contexts might be designed or implemented by taking principles of learning theories into consideration.

Learning theories are classified into three groups: behaviourism, cognitivism, and constructivism. Muirhead (2000) states that learning theories are most typically utilised during the creation of educational environments. He also stresses that all of these theories were developed at a time before learning was delivered through technology.

Each of the above groups suggests that the learning process depends on different assumptions derived from ancient philosophy regarding the mind, knowledge, role of genetics and the environment.

2.1.3.1 Behaviourism theories

Human behaviour refers to acts performed by the individual (Daim, 2011). The first paradigm in psychology was behaviourism which is based on a variety of underlying assumptions relating to methodology and behavioural analysis (Harre, 2006). Behavioural theories are divided into two categories: relational theories and functional theories. Relational theories emphasise that learning is the connection of the association between natural stimuli and certain responses (in Pavlov's experiment the stimulus was the bell to the dog and the response was the secretion of saliva in expectation of food). On the other hand, functional theories highlight the functions of behaviour and focus on the association between stimuli and behaviour such as learning by trial and error (Salkind, 2004).

In reviewing behaviourism, behavioural theories provide a helpful framework for understanding human behaviour within organisations and teams (George and Jones, 2012). Hence, behavioural theories have concentrated on the interpretation of that behaviour by managing it, modifying it or directing it. All of these operations have been carried out to achieve the objectives of an organisation. Behavioural theorists believe that human behaviour is a set of habits that may be acquired and learned during the various stages of human growth, and that those habits are controlled by laws relating to the brain.

To conclude, there are some assumptions of behaviourism such as that behaviour is acquired by experience or association and that learning is not instinctive, and people are born with a clean slate. In addition, learning depends on the use of reinforcement and follow-up to the behaviour of the learner, but learning that is built on punishment is negative learning.

2.2.2.1 Cognitivism theories

Some learning theories are concerned with learning processes which occur within the human brain rather than behaviour. Such theories are called cognitive theories and include Cognitive Development theory and Information Processing theory. Cognitive Development theory was conceptualised in 1962 by Jean Piaget as an alternative to Behaviourism theory (van Merriënboer and de Bruin, 2014). In this interpretation of learning, cognitivism theories emphasise the importance of the relationship between the behaviours of humans (Howe, 1976). They also focus on people's ideas and their previous experiences and mental abilities, such as their ways of thinking, memory and cognition.

Cognitivism theories differ from behaviourism theories in that they are not concerned with the relations between behaviours or results; learning takes place through observation. Cognitivism theory assumes that human beings are more than just their actions; they think, know and remember, and all these things must be inferred from what they say, not just what they do (Leonard, 2002). Cognitivism theorists use different language from behaviourists; they talk about memory and perception, attention, meaning and organised ideas rather than about response, stimuli and reinforcement. Cognitive theories emphasize that learning is a serious attempt by individuals to understand the world around them through the use of cognitive processes available to them such as cognitive thinking (Mortimore, 2003). Cognitive theories suggest that the human being is rational and has free will and therefore is able to make appropriate decisions when required (Baer, Kaufman and Baumeister, 2008).

To summarise, some important principles of cognitive theory, indicate that learning is an active process; therefore, the human being has to obtain valuable knowledge to understand and learn. Also, previous learning affects and facilitates new learning. In addition, cognitive theory emphasises internal processing, for instance, perception, interpretation, decision-making, receiving information, storage and retrieval and processing. All information that passes through the human brain follows three stages of memory: sensory, short-term, and long-term. The learning process has been interpreted in accordance with the principle of similarity between the cognitive processes that occur within the individual and those that occur in the computer. Moreover the human being is not a programmed animal that responds to stimuli, but actively participates in order to learn.

2.2.2.2 Constructivism theory

In the past, according to 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 (Vegas and Umansky, 2005). However, modern theorists differ in that they concentrate on the students themselves and how to create an individual learning experience for each student. In theory, each student may have their own particular ideas and unique way of acquiring knowledge (Kincheloe and Horn, 2007). These views are ascribed to constructivism theory.

Constructivism theory plays a crucial role in educational institutions and higher education, and educationists tend to support it. Constructivism theorists believe that humans learn by constructing their own understanding and knowledge and this knowledge can be reflected on new experiences (Wang, 2011). Learning, according to constructivism theory, is not just a constant change in behaviour resulting from experience or enhanced by training, but real learning is the change that occurs from meditation on cognitive processes (Adjibolosoo, 1995). This theory also describes the human being as an active learner with developed knowledge.

To conclude, the main hypothesis of constructivism theory is that learning is an active process, so learners construct their own knowledge and they learn how to learn. Also, learning consists of language which has a profound effect on the learning process. Learning is a social activity associated with the individual coming into contact with others: the teacher, peers, family and friends. Learning does not occur instantly, but it takes time, and real learning needs individual ideas to be re-checked again and again, which leads to reflection

and testing that in turn leads to learning. Learning is a contextual process, so humans learn from the relationship between what they know and what they believe, and approve or reject. In addition, previous experience is necessary for learning to take place; it is unlikely that the integration of new knowledge will occur without having previous learning.

2.2.2.3 Connectivism theory

Connectivism theory, also known as digital age theory, explains how internet technologies may create many ways for people how they learn and share information over the globe. Siemens (2005) developed and defined connectivism theory as “the integration of principles explored by chaos, network, and complexity and self-organisation”. He stresses that the learning process is actionable knowledge and depends on specialised connection information sets that enable us to learn more. He describes it as the distribution of knowledge across a network of connections. The engagement of learners via the network makes the learning process a social environment. According to Siemens (2005) some of the principles which were developed to form this theory are summarised as follows:

- Knowledge depends on diversity of opinions
- The learning process is a connection of specialised nodes
- Learning resides in non-human appliances
- There is a capacity to know more than what is already known.
- Connection is necessary to maintain ongoing learning
- Connection is a key point and the relationship between concepts, fields and ideas
- Choosing what to learn is seen via shifting the reality
- Decision-making itself is a learning process

According to connectivism theory and its principles, the learning process depends on the learner on the one hand and the connection nodes on the other. Also, there is a strong relationship between concepts and ideas via connections which may create new opinions and bring about continual learning.

2.2.3 Learning Styles

As previously stated, learning theories concentrate on human learning and illustrate how the learning process takes place in humans, while learning style theories explain the different

ways, methods, and techniques, which enable the learner to make progress within the learning process (Pritchard, 2013). Knowing about different styles of learning enhances how effectively teachers are able to teach their students and enables them to direct the learning process. Some theories have been applied regarding styles of learning such as experiential learning theory and multiply intelligences theory.

2.2.3.1 Experiential learning theory

Experiential learning theory is a common style of learning which was first introduced by David Kolb (1984) who developed a new paradigm in learning styles. This paradigm contains four types of learning style, convergent, divergent, assimilative and accommodative, and according to Kolb was based on the ideas of various 20th century scholars and later revised by him (Kolb, 2005). According to experiential theory: learning is best conceived as a process, not in terms of outcomes; it is useful to engage and involve learners in the learning process which includes participation and feedback in order to improve and enhance the learning process, particularly in higher education; the learning process works best when it presents students' ideas and thoughts regarding a topic, which can then be refined, tested and integrated to generate new ideas and create knowledge; resolution of conflicts in opposing modes is required to drive the learning process, which may reflect a new way of thinking and understanding knowledge; synergetic transactions between the learner and the environment, result in learning, which occurs through a dialectical process of assimilating to accommodate new experiences in current concepts and the absorption of existing concepts to bring about a new experience; finally, knowledge is created from the learning process during the transformation of experience.

2.2.3.2 Multiple intelligences theory

According to Gardner (2011) multiple intelligences theory represents seven styles of acquiring knowledge during the learning process, although he said they were not limited to the original seven and considered the existence of other later. The seven styles take into account the fact that people learn in different ways and differ in how they learn depending on their existing skills or abilities and their intellectual capabilities. Teachers should take into account these different types of learning style. For example, some students learn through images or pictures, other students learn through music or sound, and others learn through

language and prefer talking and listening. According to the multiple intelligences theory, Gardner (2011) cites the following styles:

2.2.3.2.1 *Linguistic style:*

Students who favour this style learn most effectively using language. They usually have superior linguistic skills and abilities with a wide vocabulary which enables them to deal with language easily, whether oral or written.

2.2.3.2.2 *Logical style:*

This style suits students who enjoy using logical operations, for example, deduction and generalisation, and who like to categorise patterns and solve problems. Students who prefer this style are very keen to find solutions using comparison between numbers and objects. They also like puzzles and enjoy difficult games.

2.2.3.2.3 *Spatial style:*

This style is suitable for those who have the ability to visualise shapes and pictures of objects. Students who prefer this way like to learn and explain things via stored images or pictures in their minds. They learn most effectively by watching videos and movies.

2.2.3.2.4 *Musical style:*

Some people are more musical than others and have a special interaction with music and so are able to learn through music and rhythm. They have the ability to recognise, compose musical tones and have a sense of sounds and rhythm patterns. They spend a great deal of time listening to music, because it helps them to learn more effectively.

2.2.3.2.5 *Bodily style:*

Learners who prefer this style enjoy learning using their body or hand movements. They express their ideas and knowledge using body language. They are often seen walking and moving around to convey their feelings.

2.2.3.2.6 *Interpersonal style:*

People who have the ability to communicate with others benefit from this style of learning as they understand and appreciate other people's thoughts and ideas. These people are active and are very keen to create useful relationships within their society.

2.2.3.2.7 *Intrapersonal style:*

Learners who prefer this style are aware of their own strengths and weaknesses and those of the world around them. They are able to recognise the relationships between things and phenomena. These learners have a deep understanding of themselves and are self-motivated, therefore they prefer self-study.

2.1.5 Factors of Learning

Learning is an interactive process which requires shared interaction between humans and the environment (Klemm, 2005). There are some factors such as maturation and readiness that can influence and improve the learning process, as outlined below:

2.2.3.3 Maturation

The concept of maturation indicates sensual, physical and neurological changes in the human being (Salkind, 2004). Maturation is considered a key factor in the learning process, therefore some patterns of learning or experiences will not be acquired unless the individual has attained full maturation. For instance, when a child wants to walk he needs to learn and exert some physical effort in order to do so; however this cannot be achieved without maturity of his feet and muscles. In other words, the child cannot learn if there is a lack in his development (Coon *et al.*, 2010).

2.2.3.4 Readiness

In addition to maturation, another necessary factor for the learning process to take place is readiness. The readiness factor refers to the individual having psychological and mental preparedness (Murphy and Fogarty, 2009). This inspires people to learn, and arouses their interest in a particular skill, and when people are ready to learn it is bound to happen (Ramsey and Legg, 2006). Readiness can apply to students when they come to school, in terms of their age, development, or mental or physical state. For this reason educationists are very keen for students to be ready before establishing their schooling.

2.2.3.5 Motivation

Baldoni (2005) defines motivation as an intrinsic response that comes from inside and cannot be imposed from outside. It is intrinsic when someone is interested and enjoys carrying out certain tasks or work. It is a state of tension which may be provided or elicited by internal factors such as desires, trends, needs or interests, or external factors such as external stimuli

and motives (Huitt, 2001). It is a crucial factor that contributes to the improvement of the learning process and increases the efforts of the individual during that process. It can also direct the individual toward appropriate learning resources and facilities. The learning process can be affected by motivation in terms of generating or directing the appropriate behaviour toward learning (Ryan and Cooper, 2012). Motivation leads to the use of suitable procedures and facilities in order to achieve results or to maintain constant and continual learning.

2.2.3.6 Experience

Experience, as a factor, is not only very important for the learning process but also in all aspects of human life. For instance, when people want to work in a company or institution they will be asked about their experience, as having previous experience will usually help them to carry out the work more effectively. When people have had previous training and experience in a particular field they will have acquired abilities and skills which enable them to perform their duties. Experience also increases opportunities for success in the learning process and reduces the efforts required by the learner, as well as saving time (Helm and Katz, 2011).

2.2.4 Measuring Learning

The learning process is usually measured and judged by observing the performance and outcomes attained by learners (O'Farrell, 2002). Performance may be seen as a reliable criterion-referenced measurement for determining whether or not learning has occurred (Sax and Newton, 2010). Tools and methods of measurement of the learning process depend on the type of learning, so every type of learning has qualified and appropriate methods of measurement. There are many criteria in the learning process that can be identified and tested to determine whether learning has occurred or not, such as formative evaluation or summative evaluation.

2.2.5 Learning Design

Worldwide, a great deal of research has contributed to the design of learning technology, whether by creating a radical enhanced learning environment or inventing a new technology

via hardware, software and applications. Technology design plays an important role in the learning process, possibly saving time and effort and enhancing the outcomes of the process. Rogers (2002) offers the example of how, instead of producing a static lecture on the laws of physics, a designer could develop an interactive module that might allow students to experiment with physics without a large amount of expenditure on elaborate equipment. With respect to the learning process, technology design could improve quality and reduce maintenance requirements.

Learning design is a key process in technology learning. According to Selander (2008) the concept of learning design not only focuses on the learning activity itself but also on the temporal and material conditions for learning. Many complex educational barriers and obstacles may be caused by the new requirements of our fast-changing life and these problems can affect the quality of the educational process. The employment of technology in education in learning design can contribute to overcoming such obstacles. Learning design plays a crucial role in solving many educational problems, such as the increase in the number of learners.

The key theories behind learning design constitute new possibilities to increase the quality of teaching and learning (Britain, 2004). That is to say, the success of the educational process depends on successful learning design. Learning design is defined as an organised process which translates all the principles of the learning process to educational plans, and produces educational materials and resources (Seels, 1995). It also depends on identifying all the educational requirements and needs of learners. Britain (2004) summarises learning design, saying that people learn better by engaging in activities which can be sequenced or structured to promote more effective learning. Moreover, it is useful to be able to record learning design to share and re-use it in the future (Kordaki, Papadakis and Hadzilacos, 2007).

The user's needs and requirements are obviously the most important aspect of the learning design process, since every other process is based on these requirements. Therefore understanding the user's requirements is essential in the prototyping and designing of a learning process (Baecker *et al.*, 1995). At the same time, its role is critical for the success of interactive learning. According to the specifications of the ISO 13407 standard, user-centred design begins with a thorough understanding of the needs and requirements of the user (Maguire and Bevan, 2002). It is risky to dispense with a clear understanding of the user's requirements and it will be virtually impossible to create an effective application without it.

Just as there are many learning theories there are also many learning design models. In fact, learning design depends on learning theories from educational psychology. A number of design models can be applied to the learning process, for example, Dick, Carey and Carey (2001), ADDIE (Analyse, Design, Develop, Implement, and Evaluate) model, and Clark and Mayer model (2003).

ADDIE was developed by expert programmers, designers and educators and covers ten phases which were identified to comprise a multimedia development model: (1) define the instructional goals, objectives, and audience, (2) review and investigate existing options, (3) determine format, budget, and timeline, (4) determine the content, activities, and assessment strategies, (5) develop evaluation strategies, criteria, and instruments to determine the effectiveness of the project, (6) develop a flowchart, site map, and/or storyboard, (7) develop a prototype, (8) perform a formative evaluation, (9) complete the design, and (10) perform a summative evaluation of product and process (Frey and Sutton, 2010). The ADDIE model is a popular instructional design model which can be adapted and applied to different models. The five phases which occur in most learning design models can be seen in the ADDIE model (Branch, 2009) and are described as follow.

2.2.5.1 Analysis

Analysis is the foundation phase of the ADDIE process, and is very important in the development of learning design. It is necessary to undertake sufficient investigation into every aspect of the learning process. This should be carried out by a designer who should brainstorm to clarify, identify and analyse all possible scenarios that may be applied in the learning process. The investigation should consider many factors, including the learner's requirements and needs, content, materials, facilities, curriculum, learning goals and outcomes. Moreover, the designer should carry out some research on all the relevant techniques which could provide critical information for the next process. To conduct this phase the designer may, for instance, investigate the following questions:

Who is the learner? What are the learner's needs? What will the learner learn? What outcomes may be achieved? What content exists? What content may be applied? What options could be offered? What is the deadline for completion of this process?

2.2.5.2 Design

The designer should move to the design phase once the analysis phase is finished and they have a clear vision and notion of the overall learning system. This includes the goals which have been determined and detailed content that has been incorporated in the analysis phase. During this phase the designer draws on and creates a comprehensive structure of the prototype on paper. The content can also be developed within this phase. In addition, learning strategies can be determined which might include, for example, strategies of organised and sequenced content, strategies of interaction between learner and content, as well as strategies of assessment (Kruse, 2002). Important consideration should be taken throughout and testing all relevant concepts during the design phase will save time and effort.

2.2.5.3 Development

Successful development is based on obtaining comprehensive information during the analysis phase as well as taking the right decisions during the design phase. Clearly, in the same way that the prototype has been defined in phases one and two, a new framework needs to be formed for the development. So, in this phase the designer can convert a plan into a viable work. Also, the designer can determine all the facilities and media that might support the learning process within the prototype.

During the analysis and design phases a new platform may be created for the learning process. Paper-based work may be produced in this phase consisting of work materials and plans. Draft versions of the whole system can be generated in this phase and unsolved issues and problems may appear which might inspire the designer to predict appropriate solutions.

2.2.5.4 Implementation

Execution of work may be applied in this phase, possibly with the involvement and interaction of the learner and content for the system. The aim of the implementation phase is to check whether or not the system meets the learner's needs and requirements. It involves actual delivery of learning objectives to the learner throughout the learning process, and training must be an integral part of this phase. During this phase the designer also obtains feedback that may allow him to progress to completion of the project or, if necessary, to redesign the system. Some challenges or obstacles may be observed and so the designer will be able to refine and redesign the prototype. It is important to realise that this phase is just a

part of the design process and not the end, because the quality and variety of the context of the design process requires all phases to be implemented.

2.2.5.5 Evaluation

Evaluation is the systematic assessment of the worth or merit of the learning process using criteria against a set of standards (Clark, 2012). It plays a crucial role in learning design and is intended to improve the whole learning design process, and therefore continues throughout from the beginning to the end of the entire process. The purpose of this phase is to ensure that the learning design meets the requirements and needs of the learners. Two types of evaluation can be applied in this phase, formative evaluation and summative evaluation, and the effectiveness and weakness of the system can be measured.

2.2.5.5.1 Formative evaluation

Formative evaluation refers to evaluating continuously during each phase and between different phases. It aims to improve learning design before presenting it as the final version for implementation. Formative evaluation often focuses on the development of a mentoring scheme (Miller, 2004).

2.2.5.5.2 Summative evaluation

Summative evaluation usually occurs after the implementation of the final version of the learning design. This type of evaluation assesses the overall effectiveness of the learning design. In other words, it concentrates on whether or not the learning design has achieved the intended effects rather than providing information about improving it.

2.3 Technology

2.3.1 Definition of Technology

The Oxford Dictionaries website defines the word ‘technology’ in many ways as follows: The origin of technology “early 17th century: from Greek *tekhnologia* 'systematic treatment', from *tekhne* 'art, craft' + *-logia*”. It also denotes the application of scientific knowledge for practical purposes, especially in industry, and advances in computer technology (Oxforddictionaries.com, 2014). It means machinery and equipment developed from the

application of scientific knowledge. It also refers to the branch of knowledge dealing with engineering or applied sciences. There are many other definitions of ‘technology’. For example Liu *et al.* (2009) state that technology is “a kind of systematic expertise associated with production processes of goods and services, and is a combination of the means and skills created and developed by human to realise the needs of society”. According to Ferguson (2009) UNESCO defines it as a creative process that helps people to use facilities, tools, resources and systems to overcome obstacles and problems and to enhance control over the man-made or natural environment in order to improve the human condition. From the above definitions, the broad concept of technology can be understood as a method of thinking, and using knowledge and skills to solve problems, to achieve man’s needs and to increase his abilities.

2.3.2 Importance of Technology

Today, technology-enhanced learning is a fundamental tool which is widely available in the universities of developed countries (Hamidi *et al.*, 2011). There is no doubt that recently there has been an increase in careers that depend on the development of technology as well as in computer-based jobs; for example, learning, banking, and business are all in high demand. The world is currently witnessing a revolution in technology which has brought about huge changes in the workplace and in the lives of young people (Nallari *et al.*, 2011). Therefore the use of technology by teachers can have positive benefits on the academic sector, but it is also required to develop skills and knowledge to enable educators to transfer technological potentials for solving the learning process problems (Ottenbreit-Leftwich *et al.*, 2012).

Technology may have a positive effect on the learning process by enhancing learning and improving the ways in which teachers deliver their knowledge to students; it is considered a crucial part of the learning process. Ottenbreit-Leftwich *et al.* (2012) discuss how using technology can support the learning process. For example they emphasise that the use of technology may provide teachers with a constant source of professional growth and facilitates higher-order thinking skills, which enables teachers to present knowledge easily. Using technology tools such as Multimedia App, social networks, blogs, and Google bookmarks is useful for teachers and learners in the learning process. According to Donnelly and

McSweeney (2009) technology has significant potential to support or even transform the learning experience for all learners within higher education.

To conclude, technology creates pedagogical opportunities that were previously impossible to implement in the learning process. The development of learning systems with the use of new technologies, such as e-learning and active learning, is just one example of the rapid development in most aspects of daily life that is taking place in many countries throughout the world. This rapid implementation of developments is due to the improvement of technological knowledge in modern societies which has made the use of technology a necessary change for developing and improving learning systems, because it will make them faster, easier, more sustainable and reusable for the future.

2.3.3 Technology-enhanced Learning

Nowadays, most teachers consider the use of technology in the learning process to be a crucial part of learning enhancement (Ryan and Cooper, 2012). For example, UK schools have an excellent reputation for their use of technology in many areas of academic innovation and strategic development (Howe, 2011). Within the context of the relationship between learning and technology, technology has made a great impact on the interactivity and efficiency of the learning process. It has enhanced learning to make it easier, more effective, faster, more accessible, and reusable. Within the learning process technology may be adapted to provide learners with tools, materials, and equipment to ensure ease of access, and it offers a wide range of multimedia applications and communication systems which may be helpful in the learning process. Therefore, the use of technology in learning is extremely powerful, particularly when it is used as a tool for problem-solving or critical thinking (Ringstaff and Kelly, 2002).

Within the last few decades, the discovery of many technologies has been considered by some theorists of pedagogy and educators as a solution for various educational issues. For instance, the Internet is a technology that can be used for the development of solutions to such problems in line with the requirements of modern times.

There is an ongoing relationship between technology and education in many aspects of learning. Technology has contributed significantly to the improvement of education and

support in all areas. Perhaps the most notable of these areas are e-learning, computer-based learning, distance learning and technology-enhanced learning. The development of any educational system and its dependence on learning technology is no longer a luxury, but a necessity to ensure the success of any educational system, and an integral part of its structure (Wheeler, 2008).

Learning technology refers to the organised and systematic process of learning and education, which might be implemented and evaluated in the light of specific objectives. Learners who use technology effectively for learning may achieve more positive outcomes than those who do not use it (Cooper, Goswami and Sahakian, 2009). Also, they may gain some learning skills such as sustaining concentration or problem-solving, and might have more confidence and motivation in the learning process (Winter *et al.*, 2010). Many examples of the benefits of using technology can be seen in the learning process. For example, there is no longer a need for learners to find information or data in traditional libraries, however using technology, learners might be able to find what they need quickly in online libraries, or encyclopaedias and wikis.

Quality is an important issue in the learning process. Gilbert, Morton and Rowley (2007) state that utilising technology in the learning process could enhance the quality of learning and improve access to education and training. For example, the use of classroom technologies could enhance the quality of the learning process by learners' engagement in virtual and face-to-face exchange environments and by facilitating better access to learning resources such as electronic libraries.

In addition, technology might reduce the cost of learning and improve the cost-effectiveness of education. For example, via distance learning technology could cut travel expenses and provide feasible training for employees or learners about new products and experiences (Darbyshire, 2003). Goodman (2001) stresses that new technology has created possible innovative learning environments at less expense, such as virtual schools, within distance learning. For example, a virtual school might produce enhanced learning by expanding access to learning, and providing learning opportunities for a huge number of learners (Barbour and Reeves, 2009).

Moreover, new technology offers learners a wide range of opportunities to share other people's experiences whenever and wherever they want. People can contact each other and swap knowledge as well. Furthermore, in real time and in virtual groups, learners can also

share content and interact together and receive feedback or comments (Lantos, 2010). This can occur with some new internet technologies such as Facebook, YouTube, Twitter, forums and blogs, or Mobile App technologies such as WhatsApp, Line and Skype.

As Donnelly and McSweeney (2009) indicate, there has been an enormous change from the traditional learning process, and technology might change the roles of those involved in the learning process as it puts teachers in the role of learners alongside their students. According to Naidu (2003) technology transfers the roles of teachers “from being the sage on the stage to being the guide on the side when fostering independent student learning”. Both teacher and student directly communicate and interact in order to gain new skills and knowledge. Instead of being a leader, teller, and tester as in traditional teaching environments, within integrated technology environments teachers have to view themselves as coaches or facilitators (Ryan and Cooper, 2012). Teachers guide students as they use technology to discover facts and concepts. So they can change their way of delivering content to the students, such as monitoring students’ projects, guiding their efforts, and providing feedback.

Even in academic and higher education institutions, technology plays a crucial role in contributing to the development of educational issues such as sustainable content management (Donnelly and McSweeney, 2009). Sustainable content management offers a rich learning environment that might be based on open sources, which motivate developers and designers to create and build an integrating learning environment and applications to enhance learning process. Technology can offer a wide range of applications to enhance the learning process. It might provide learners with a generic service for sharing any application; therefore learners can control the shared application as well (Courtiat, Davarakis and Villemur, 2005)

2.4 Accessibility

Accessibility is one of six dimensions that are undertaken in this research. The simple definition for accessibility is when users are able to access and use an application’s content. It is defined as the “extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities, to achieve a specified goal in a specified context of use” (ISO, 2008). Easy accessibility to any software presents a wide opportunity across the globe. According to ISO Content

Accessibility Guidelines (WCAG 2.0), the standard for web content accessibility should meet the needs of individuals (World Wide Web Consortium Recommendation, 2014). Therefore, taking the users' needs into consideration is an important point and a key issue in developing a new web application to make it more easily accessible. Some issues are related to users being able to register, sign in, and sign out, and others are related to location of the system such as being able to run the system properly. The users' needs also require specific features for any application to be in a proper format. Martinez-Normand and Pluke (2014) suggest how to represent the accessibility of some application features, as shown in Figure 2.2.

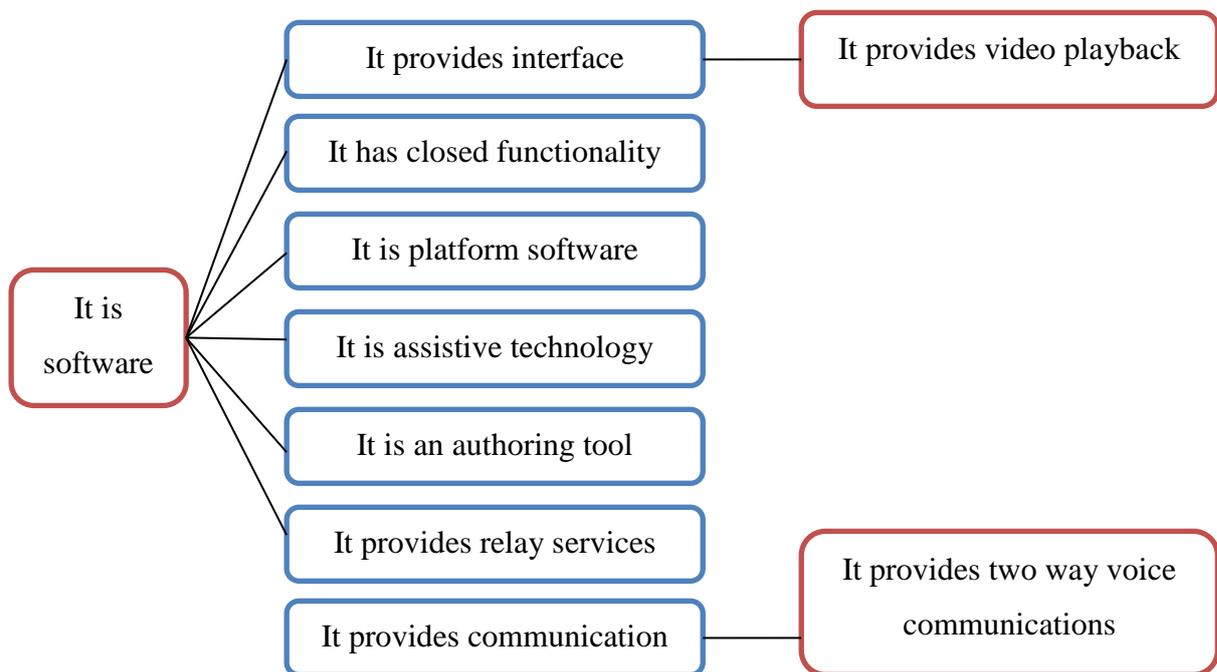


Figure 2-2 : Application features

2.5 Usability

Usability is another issue, linked to accessibility, which should be considered when creating a piece of software. Usability means that when developing a system or an application the developer should make sure it is easy to use and to deal with its content. It is defined in ISO 9126 as “a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users” (ISO, 2011). There is another definition for usability from ISO 9241-11 which is “The extent to which a product can be

used by specified users within a specified usage context to achieve specified goals effectively, efficiency and satisfactorily (ISO, 2008)". From these definitions it is clear that this term is linked to users' requirements as they appear in the definition standard. This indicates that users have specific requirements and needs that should be considered with regards to the usability of a product. To explain these definitions Ahmed (2008) explains that the capability of the software needs to be understood, learned, used and liked by the user, when used under specified conditions. With regard the usability of the IELTS user must have accessed to the right screens as Norman and Nilsson 2010 stated that "when users think they did one thing but actually they lose their sense of controlling the system because they don't understand the connection between the actions and result". Attempts have been made to broaden the perception of quality, for example in ISO/IEC 9126 which categorises quality from the user's perspective as functionality, reliability, usability, efficiency, maintainability and portability (Figure 2.3).

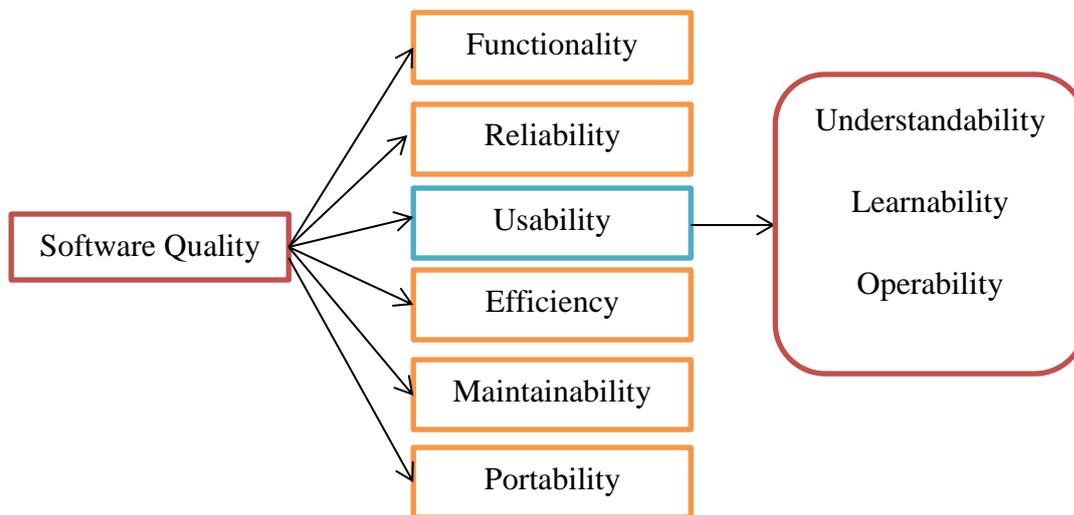


Figure 2-3 : Software quality characteristics

2.6 Interactivity

2.6.1 Introduction

The development of diverse human skills and abilities such as acquiring knowledge and interaction with new learning machines has become a necessity that should be achieved, especially in the construction and development of the learning process. Therefore interactivity is an important new technology that has underpinned the learning process in recent years. The rapid evolution of technology proves that there is growing evidence regarding the value of increasing interactivity to enhancing learning, whether between individuals or in group activities (Beauchamp and Kennewell, 2010).

Applications developers and computer researchers are not taking full advantage of computer applications, unless they focus on interactivity (Gustavsen and Tilley 2003). The use of interactivity has increased with the release of new communication technologies such as mobile apps. Nowadays it is clearly evident in public places such as trains, buses and stations just how much young people interact with their mobile phones, laptops or tablets. They appear to be in their own individual world when they communicate via these devices, projecting a range of different emotions that would lead us to observe that they have full interaction with their gadgets and spend a great deal of time on these interactions. Such behaviour may reduce face-to-face interaction between human beings, with people interacting more with their computers or mobile apps to exchange or participate in knowledge acquisition or skills development.

2.6.2 Definition of Interactivity

Interactivity is a powerful technology tool that can be used in the learning process to make it more effective and worthwhile, as well as to generate a satisfactory learning environment. Interactivity has played an important role in the development of learning skills, and the acquisition of knowledge. From various perspectives, interactivity has been explained in diverse and numerous fields. It is two-way communication between learners or between learner and machine.

According to the Oxford Dictionaries website, interactivity is when two people or things influence or have an effect on each other. It also means: allowing a two-way flow of information between a computer and a computer-user; responding to a user's input: a fully interactive map of an area (Oxforddictionaries.com, 2014). Domagk, Schwartz and Plass (2010) define interactivity as "reciprocal activity between a learner and a multimedia learning system, in which the reaction of the learner is dependent upon the reaction of the system and vice versa". Donnelly and McSweeney (2009) describe interactivity as the core of learning, which is evident at all levels of engagement. Also Yacci (2000) states that interactivity is a message loop which occurs from the perspective of the learner and back to him after being processed from a machine or another learner. Another definition of interactivity is that it is a process-related, variable characteristic of communication settings that could lead to engagement and sociability between people and computers (Rafaeli and Sudweeks, 1997).

2.6.3 Human-Computer Interaction

Many users learn how to operate a computer using a keyboard and mouse to point, click and select icons, all of which are types of human interaction with the computer (Harper, 2008). During learning process interaction with devices has become vital to the success of users (Schmidt, 2000). Regarding the revolution of computers and other new devices such as mobiles and tablets, there is an interaction with apps which may take the learner closer to knowledge. Human computer interaction is built on the hypothesis that the computer has a specific understanding of user behaviour in a given case (Schmidt, 2000).

In recent years, there has been an increasing shift in the use of a single user interface of multimedia toward supporting the interaction between users via groups that work closely together, for example during training courses or meeting sessions (Barthelmess *et al.*, 2006). According to Hollender *et al.* (2010) there are two main aspects of HCT regarding the learning process. The first aspect is that the novice user has to learn how to use a computer system in order to complete specific tasks, while the second relates to learning application and aims to enhance knowledge and skill acquisition within the learning process.

For example, when using some internet applications, such as Facebook, users interact with their features and receive a huge amount of response. Facebook, as an interactive application,

allows users to produce, share, and participate in a number of multimedia activities, text, pictures, and videos.

2.6.4 Multimedia

Computer users transfer their ideas, expressions, feelings, opinions, etc. to others via sets of tools such as text, image, graphic, audio, video, and animation. All of these things together can be called multimedia, which has become an important tool in information technology. Multimedia is a combination of two or more media. A practical definition from Hamad (2011) indicates that, “Multimedia is a field of study concerned with the computer controlled integration of text, graphics, drawings, still and moving images or video, animation, audio, and any other media where every type of information can be digitally represented, stored, transmitted and processed”.

Multimedia is used significantly to provide users with more interaction with application interfaces, which is very important particularly in the learning process. According to Kwan (2011), using multimedia enhances learners’ control of the learning process so they can easily track their learning process, thus it can help to achieve a better learning experience for learners. About 80% of learners find real-time lectures are useful for learning and 86% are satisfied and find e-learning flexible (Kwan, 2011).

Within the learning process the implementation of multimedia can be valuable in increasing the size and type of information available to learners, as it can offer layers of useful resources and provide useful information, such as encyclopaedias that may provide rich links to videos and additional articles on specific topics of interest (Shank, 2005). The development and deployment of an interactive application moves forward quickly, therefore interactive applications ought to include integrated multimedia which affects the learning process making it faster and more cost effective.

2.6.4.1 Types of multimedia

Multimedia has become an inevitable part of any application, whether interactive application or presentation. As previously stated, multimedia is a collection of integrated data types or elements such as text, image, audio, video, and animation. These types can be integrated to create or develop an interactive application that may be used to enhance the learning process.

Multimedia in classrooms can be extremely valuable; for instance text size can be adjusted for readers, audio can train users in correct pronunciation, video shows real daily life (Shank, 2005). The use of graphics and animation in multimedia applications may be more valuable than using text format. For example, the use of animations enhances learners to quickly grasp underlying complex and abstract concepts (Korakakis *et al.*, 2009). Regarding graphics, for example, many pages of text might be necessary to describe the UK, but with the use of graphics it is only necessary where to view an interactive map of the UK, which will save both time and effort. Video as a multimedia tool offers rich opportunities and easy access for the learner whenever and wherever they want to learn.

2.6.4.2 Multimedia applications

Nowadays, the use of multimedia applications is rapidly growing, particularly in education. Multimedia applications can offer safe and authentic knowledge, as well as providing practice exercises which many academic members require for their students. Storage resources and network multimedia applications are being designed, such as presentation applications or interactive applications, and a wide range of computer software is being improved and developed on a wide scale to provide various applications which could allow individualised use and learning. This grants designers and developers an important role in developing their applications to make them more interactive and more effective. In considering the impact of multimedia on the learning process Astleitner and Koller (2006) stress that there is clear evidence that multimedia applications can enhance accessibility, reusability, motivation, and interactivity more than traditional learning methods.

In essence, multimedia application interfaces enhance learner experience to increase the speed of accessing knowledge and information. The interface of any application should include some multimedia sources such as text, navigation, image and animation, which can be combined to create an integrated application and support its interactivity. Integrating all of these combinations of media in a computer allows the use of existing computing power to represent information interactively (Steinmetz and Nahrstedt, 2004).

2.6.5 Interactive E-learning

Modern changes and the emerging evaluation of information technology have encouraged the higher education sector to move from the conventional model toward new values such as

interactive e-learning. In general there are considered to be three key elements in the learning process: student, content and teacher. Therefore, in the traditional classroom there is normally some sort of interactivity in sessions, whether between students and content, students and students, or students and teacher. Within the traditional classroom there is a limited amount of interactivity as there may not be enough space or freedom for students to interact and communicate with extra information about the content. On the other hand, in an interactive e-learning class students can communicate more than in a traditional class, in particular with the content; for example, students have more freedom to navigate to certain relevant topics or sites and they can retreat from the teacher's control to some degree (Park, 2008).

Based on constructivism theory, learners can build their own understanding and knowledge as usually happens in interactive learning in general, and particularly in e-learning. For example, learners can perform certain tasks and produce deliverables, which could take the form of a data sheet, presentation, Web pages, or portfolios, to construct their perception of the required topic (Klemm, 2005).

2.6.6 Interactive Lecture

Most commonly, universities and higher education institutions deliver knowledge to their students via lectures or tutorials. The lecture is much more abstract than a tutorial and, in comparison, there seems to be a greater degree of interactivity in a tutorial than in a lecture. Compared with other teaching methods, the lecture requires a great deal of preparation time from the lecturer, despite it being the least engaging method, with learners not being actively involved. In tutorials the learner has more work to do and is more involved, whereas in lectures the learner plays a passive role.

When discussion is increased to provide more interaction and participation in lectures between learners, or between lecturer and learners, it is referred to as an interactive lecture. Without using any technology or equipment, a lesser degree of interaction between lecturer and learner can occur in the lecture, whereas if diverse materials or prepared slide presentations are used as technologies that will enhance the interactivity of the learning process, a new paradigm will be introduced which is the e-lecture.

In tertiary education, contingent teaching can be delivered to learners in two ways, either via the conventional lecture or the e-lecture. Recent technological developments have provided a new model of lectures for the transition from the one-way lecture to the interaction approach, which allows learners to actively participate in lectures (Turnock *et al.*, 2007). Interactive lectures are designed to obtain an immediate response from a group of learners to specific content. According to some studies which have been conducted such as Savoy, Proctor and Salvendy (2009), Jadin, Gruber and Batinic (2009), and McMinn (2012) e-lectures are delivered to learners via presentation, segments or video streaming. According to Draper and Brown (2004) an e-lecture has more benefits than a traditional lecture. For example the e-lecture can: improve lecturer attention, focusing it on learners' outcomes; make lectures more enjoyable; allow learners to participate more and to engage actively in lectures; and provide more motivation for learners.

2.6.6.1 Related work

Several experiments and researches have been conducted regarding the e-lecture and the interactive lecture, such as Savoy, Proctor and Salvendy (2009), Jadin, Gruber and Batinic (2009), and McMinn (2012). 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 previous studies presented an e-lecture of the same type which was dependent on video streaming or presentation segments. This means that limited interaction was required from the end user (learner) which was represented only by certain buttons such as play, pause, forward, rewind, and stop as needed.

Savoy, Proctor and Salvendy (2009) compare a lecture delivered using traditional presentation and an e-lecture with the presence of PowerPoint presentation. They argue that the information on PowerPoint presentation slides for lecturing has more perceived importance rather than other information. Also, they suppose that more information is retained when PowerPoint is not used than when it is. In addition they discuss whether students prefer a traditional lecture or an e-lecture. They delivered their lectures over four weeks to measure the retention of lecture information presented to students. A total of 61 students were randomly selected to participate in the experiment, 19 females and 42 males. Forty-five students participated in both traditional lectures and PowerPoint presentations; the rest of the students received the lecture with no class. All 61 students were given

questionnaires to complete. All students were delivered the same content and information in both lectures by the same professor. The course was cross-listed in Industrial Engineering and Psychology. The class met three times a week for 50 min for 16 weeks. Class content was based on a draft of the second edition of the textbook. To assess participant performance related to the type and amount of information retained with a given delivery style, a paper-based quiz was developed. The quiz consisted of 20 multiple-choice questions, each of which had four answer choices. Ten questions were included that referenced content presented to the students during each lecture.

The finding of this study was that the retained information hypothesis was not supported because there was no significance as ($t(59) = -0.76, p = 0.45$). Regarding the hypothesis of importance of information using PowerPoint presentation, the finding was not supported either because the mean rating of participants was ($t(44) = 0.26, p = 0.80$), which means there was no significant difference. According to the hypothesis regarding which type of lecture students preferred, the finding from the questionnaires indicated that PowerPoint presentations were preferred over traditional presentations.

Regarding the integration of e-lectures in high schools, McMinn (2012) investigated whether the use of the e-lecture has an impact on students' performance or not in an American History classroom, by comparing the traditional lecture with the e-lecture and their effects on students' results. A total of 44 students participated, divided into two groups: Control Group A (21 participants, 12 males and 9 females) for the traditional lecture and Experiment Group B (23 participants, 9 females and 14 males) for the e-lecture. Lectures were delivered to the students in the following unit sequence: pre-test then traditional lecture or e-lecture, student activities, cooperative project, review, post-test and finally a student survey was conducted. The result of McMinn's research reveals that there was an improvement in students' performance when e-lectures were used compared to the traditional lecture. Therefore the average of knowledge gained from the traditional lecture was 28.6%, whereas it was 33% from the e-lecture. Another finding from the survey was that 61% of students preferred the e-lecture method, while 39% preferred the traditional lecture.

Jadin, Gruber and Batinic (2009) conducted an experiment, which contributed to learning using interactive e-lectures. Their experiment focussed on the meaning of learning strategies and involved 28 participants (14 male and 14 female students from the Johannes Kepler University, Linz). An e-lecture was delivered in this experiment, designed as an interactive video. The e-lecture, which has been selected from the University of Warwick, was about

business successes of the last century and industrial economics. The e-lecture was modified with Open world Presenter Plus version 1.24. The modified lecture can be seen in Figure 1. It consisted of five chapters, 40 slides and 13 additional links. The duration of the lecture was roughly 25 minutes. The e-lecture consisted of a video, slides, table of contents, external links and video control buttons. The slides showed pictures of mentioned persons, display diagrams and tables, along with keywords mentioned in the speech. The slides were also synchronized with the lecturer. The transitions from one chapter to the next proceeded automatically, but a table of contents allowed participants to navigate between the chapters. Therefore they had the possibility to replay chapters. Furthermore, another section in the e-lecture provided a selection of relevant external web links, which appeared throughout the lecture and offered the viewer additional resources. Participants could use the links if they wanted.

The e-lecture concerned business successes and industrial economics. It included slides and links, and video enhanced by control buttons, display diagrams and tables. The transitions from one slide to the next proceeded automatically, but a table of contents allowed participants to navigate between the slides. Two types of e-lecture were delivered, one had a written transcript, which was synchronised with spoken text, while the other had the same content as the first without the written text; the place for the text was left empty. In both cases students were allowed to replay the e-lecture but not allowed to take notes. The length of the lecture was approximately 25 minutes and after it was delivered participants were asked to take a ten-minute exam, which included ten multiple choice questions. They were also asked to complete a questionnaire in which they evaluated the e-lecture. To identify the learning strategies, certain categories were analysed such as: use of links, use of table of contents, repetitions, viewing which consisted of using the buttons (play, pause, and forward or rewind). The findings of the experiment revealed that learners' outcomes were significantly influenced by learner strategy, with the mean ratings of participants at ($F(1, 24) = 5.16, p < .05$). Regarding the e-lecture that had no written transcript, the result revealed that there was no effect on learning performance.

Demetriadis and Pombortsis (2007) conducted a study on the use of e-lectures, on the aspect of flexible learning and the efficiency of the learning process. Their study examined the flexibility of the learning experience utilising three types of e-lecture: the digital lecture, which refers to any lecture delivered through digital technology online, either synchronously or asynchronously; the live digitized lecture, which refers to any digital learning resource that

captures the experience of lecture-based instruction in the classroom; and the e-lecture which means any digital lecture format captured in the studio. The first format was the digital lecture which is available via streaming technology or optical storage media and was delivered through digital technology, either online (synchronously) or on demand (asynchronously), captured “in vivo” or “in vitro” and students attended from a distance. The second format was live digitized, which indicates any learning resource that captures the experience of lecture-based instruction in the classroom, with students participating. The third format was the e-lecture which indicates any digital learning resource in lecture format, captured in the studio.

The difference between the live digital lecture and the e-lecture is essentially a socio-cognitive issue rather than a technical one. Seventy-two students participated (26 males and nine females in the experimental group, and 27 males and 10 females in the control group). All students were taught the same content. The control group was offered the content by means of a traditional lecture while the experimental group was offered the content in an e-lecture. Both groups were involved in four phases as follows:

Pre-test Phase: A six-item questionnaire comprising short answers was administered for both the control group and the experimental group.

Study Phase: In this phase the control group attended a traditional lecture in a classroom which was delivered via PowerPoint slides that included text, graphics, and animation. The experimental group were allowed to view the e-lecture from home as many times as they wished.

Review Phase: Both groups were given six review questions to answer. In addition, the control group were asked to pose their own questions immediately after the lecture, but the experimental group were asked to meet their instructor later.

Post-test Phase: Six open-ended questions were given to both the control group and the experimental group.

The results of the pre-test in the study by Demetriadis and Pombortsis (2007) confirmed that there was no significant difference between the students in the two groups; for the control group $n=27$, $M=1.4$, $SD=1.48$, and for the experimental group $n=26$, $M=1.3$, $SD=1.16$. Regarding the review questions that were given to the students, the responses were

satisfactory for both groups. Also, their study showed that students can learn better when using e-lecturing material and their satisfaction in the flexibility of the experience.

Author name	Demetriadis & Pombortsis (2007)	Savoy & Salvendy (2009)	Jadin, Gruber & Batinic (2009)	McMinn (2012)
Study title	E-lectures for flexible learning	Information retention from PowerPoint and e-lecture	Learning with e-lectures	Lecturing for Success
Type of Application/software	PowerPoint slides	PowerPoint slides	Interactive video synchronisation with written text VS without text	Traditional lecture VS e-lecture
Application platform	PowerPoint	PowerPoint	Real player Video control buttons	PowerPoint
Lecture topic area	Computer sciences	Industrial Engineering and Psychology	Economics	History
Participants	Students n=72	Students n = 45	Students n=28	Students n=44
Methods	Questionnaires Pre-test Post-test	Questionnaires Quiz	Questionnaires Test	Pre-test & Post-test Survey
Main finding	Students may learn efficiently when using e-lecturing material and they are also satisfied with the Flexibility of the experience.	Students who attended either one of the lecture presentations performed better than those who did not attend.	There is no significant connection between learning environment and the chosen strategy	There is an increase in students' knowledge when e-lectures are used compared to the traditional lecture.
Test Learning outcomes	Pre-test and post-test	Information retention by quiz	Test	Pre-test and post-test
Test System learnability	No	No	No	No
Test System accessibility	No	No	No	No
Test System usability	No	No	No	No
Test System interactivity	No	No	No	No
Test System communication	No	No	No	No
Test System satisfaction	No	No	No	No

Table 2-1 : Summary of previous studies' results

2.7 Communication

2.7.1 Introduction

The development of diverse human skills and abilities has become a necessity that should be achieved, especially in the construction and development of the learning process. Therefore communication and effective information exchange is an important new technology that has underpinned the learning process in recent years. The rapid evolution of technology is evidence of the value of increasing communication in enhancing learning, whether between individuals or as group activities; therefore the new tools of technology promote the free exchange of ideas and sharing of best practices, enabling educators to benefit from the knowledge and skills of others (Novell, 2008). Also, new technology provides pathways for connections between students, parents, and educators, which creates strong learning communities (Partnership with 21st Century, 2009). It can be seen, particularly among the young, just how attached people have become to their mobile phones, laptops and tablets. The interaction between people and their gadgets is evident in all aspects of communication, both for social interaction and in the exchange of knowledge.

2.7.2 Definition of Communication

Communication is the way of exchanging information or ideas between two sides or more via some channel, including signs or symbols. The communication process is the answer to the following questions: Who says? What do they say? Through what Channel? To whom? With what effect? (Lasswell, 1948) Communication permeates all levels of human expertise and it is central to understanding human behaviour and also aims to change behaviour among individuals, organisations and societies. Communication is the process of exchanging knowledge and meaning by use of signs and symbols (Morreale, Spitzberg and Barge, 2007).

2.7.3 Communication Elements

Communication consists of encoding and sending messages and receiving and decoding them. In this context there are five main elements which make up the communication process. Shannon and Weaver (1959) identified the linear model as a communication model which has three elements: sender, messages and receiver. According to this model communication is seen as one way (Sadri and Flammia, 2011) and it does not represent the human complexity of communication. Figure 2.4 shows the basic elements of the one-way model of communication.



Figure 2-4 : The linear model of communication

A number of other models were developed, such as Osgood and Schramm's model which is more interactive and represents the circular communication between humans. It has more elements, such as sender, receiver, message, channel and feedback, as shown in Figure 2.5. It also offers a rich environment for communication between its users and gives them more space and freedom (Steinberg, 1995). The new channels of communication also allow individuals to deliver messages easily to public receivers, even between strangers (Lo and Lie, 2008). Communication skills are a key determinant in the creation of a virtual e-learning environment which is interactive and beneficial to students. Many students do not understand that effective communication skills need a specific language for a particular group of people, so they may find themselves using jargon or slang which may not be understood by the lecturers and thus cause a communication barrier (Iskander, Kapila, and Karim, 2010). Students do not pay as much attention when they are in online discussion groups and therefore may fail to give suggestions or feedback on various issues raised by their lecturers or other students. If communication is not a two way process, the students do not give feedback or offer comments or suggestions, which will be a hindrance to effective interactive learning online.

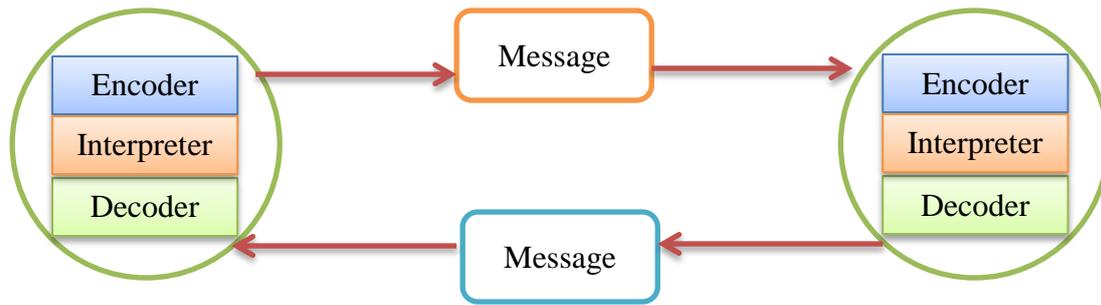


Figure 2-5 : Osgood and Schramm communication model

2.8 Satisfaction

User satisfaction is a crucial issue when developing or building software or a product because it is reflected in the software's performance. It helps developers and designers to improve and enhance, and adds value to the product's features. It also directs developers and designers to avoid negativity and disadvantages, and focus on improving their product from users' feedback and comments. In addition, it reflects the evaluation of the efficiency of the product and informs developers and designers of its strengths and weaknesses. This means that a successful product depends on users' experience and feedback. Gatian (1994) emphasises that user satisfaction is a strong measure of a system's effectiveness. According to ISO 10002:2014, satisfaction is defined as a "customer's perception of the degree to which the customer's requirements have been fulfilled" (ISO, 2014). Chin and Lee (2000) developed a model that defines satisfaction and explains the factors that help to form it. Figure 2.6 shows the factors of this model.

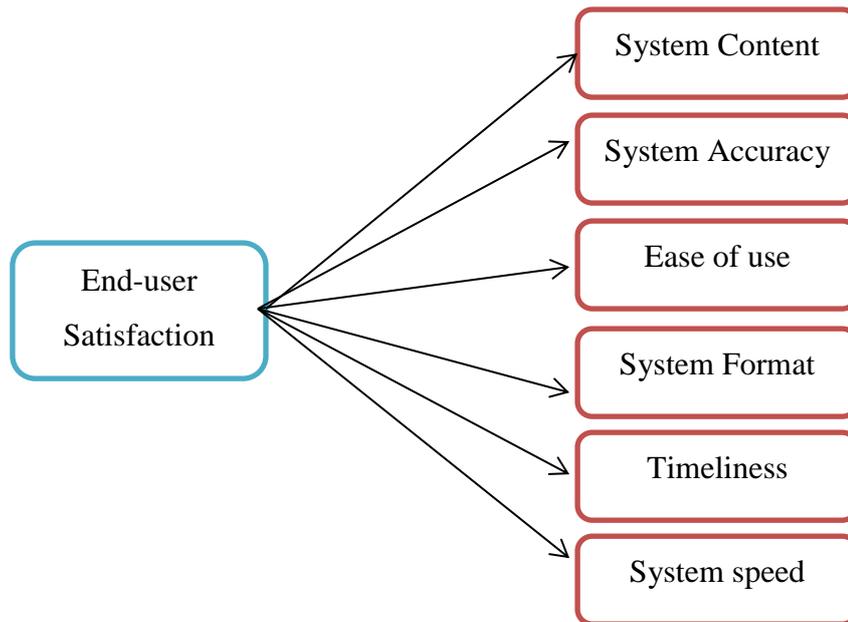


Figure 2-6 : Chin and Lee's satisfaction model

2.9 Conclusion

Six main aspects have been discussed in this chapter: learning, accessibility, usability, interactivity and communication. In terms of learning, a number of issues were discussed such as learning theories, learning styles, learning factors and learning design. The definition of technology, specifically learning technology, and the way in which it can enhance learning was described. Interactivity and other related issues were also identified. The definition of communication and its elements were discussed, and some models described. Four previous studies related to the research area were identified and their results presented. It was seen that all previous studies focused on the e-lecture as a new paradigm for lecturing in higher education which could be applied either by synchronised or non-synchronised video streaming and segment presentation. Moreover they investigated the influence of the e-lecture on students' academic achievements and the outcomes of the learning process.

The following chapter will investigate the research method and framework analysis of the current study, experiment design techniques will be explained, and data gathering will be illustrated.

3

Research Method

3.1 Introduction

This chapter discusses the methodologies employed in the research. It consists of a definition and explanation of the study design and analysis approaches. Two of the most common design techniques, between-group design and within-subject design, are assessed. The analysis approach explains how the research questions are assigned to the research dimensions and they will be answered then translated to null hypotheses.

In addition, this chapter compares and discusses the relationship between independent variables and dependent variables. It also illustrates how the data has been gathered, as well as presenting the framework analysis. Finally the research ethics and the threats to validity of the research are discussed.

3.2 Background

This research addresses six issues that could be examined by applying IELTS. Those issues were assigned respectively to the research questions Q5-Q10 as shown in Chapter 1, namely accessibility, usability, interactivity, learnability, communication and satisfaction. Therefore the main questionnaire was designed according to these six issues based on the preliminary study in Chapter 4 and the literature review in Chapter 2. These issues were tested with the aim of assessing IELTS performance and how involved the students are in working with the system which is being proposed to deliver their lectures. Also, the answers to research questions Q11, Q12 and Q13 are expected to show whether there is a relationship between IELTS performance and student interaction with the lecture content, student learning outcomes and users' ease of exchanging information.

3.3 Study Design

According to Denscombe (2010) researchers have to be selective when choosing their research methods and they should understand how to use them in the best way. Thus, the proposed research methodology for this project is mixed method, which includes practical approaches to investigating the issues raised. In any experiment the nature of data which needs to be gathered requires a number of methods of data collection: questionnaires, pre-test and post-test. Levels of usage and interaction via system record, and users' satisfaction will also be evaluated.

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 (Taylor, 2008). In this research an experiment will be carried out to implement the study. When a researcher wants to generalise their findings within a population and develop a detailed view of the meaning of a concept for individuals, it is useful to apply a mixed method design in order to capture the best of both qualitative and quantitative methods (Creswell, 2013). Therefore this experiment depends on mixed methods, quantitative and qualitative, to answer the research questions.

Quantitative method refers to numerical data collected using a mathematical or statistical tool, while qualitative method indicates non-numerical information that is not based on a mathematical or statistical tool, for instance sound, text, and images (Haegeman *et al.*, 2013).

This experiment is designed to be carried out in two scenarios. The first scenario involves the control groups, with lectures delivered by the e-lecture method as shown in Figure 3.1. The control groups support the researchers and allow them to detect any effect of the experiment itself (Babbie and Babbie, 1999). The second scenario involves the experimental groups, with lectures delivered by the proposed system, the interactive electronic lecture system (IELS) as shown in Figure 3.2.



Figure 3-1 : E- lecture



Figure 3-2 : IELTS lecture

3.3.1 Design Techniques

Experimental design is an important stage of conducting research. It is necessary to consider several factors when designing a true experiment (Jackson, 2012). This design requires strong techniques which help the researcher to understand the effectiveness of certain variables or factors that may be applied to test the research null hypotheses and examine the system's efficiency. There are many major design techniques that could be applied when carrying out

such an experiment. This experiment consists of four groups, the control groups and the experimental groups, with different conditions and variables. Therefore it requires certain techniques, such as within-subject and between-group designs as shown in Figure 3.3.

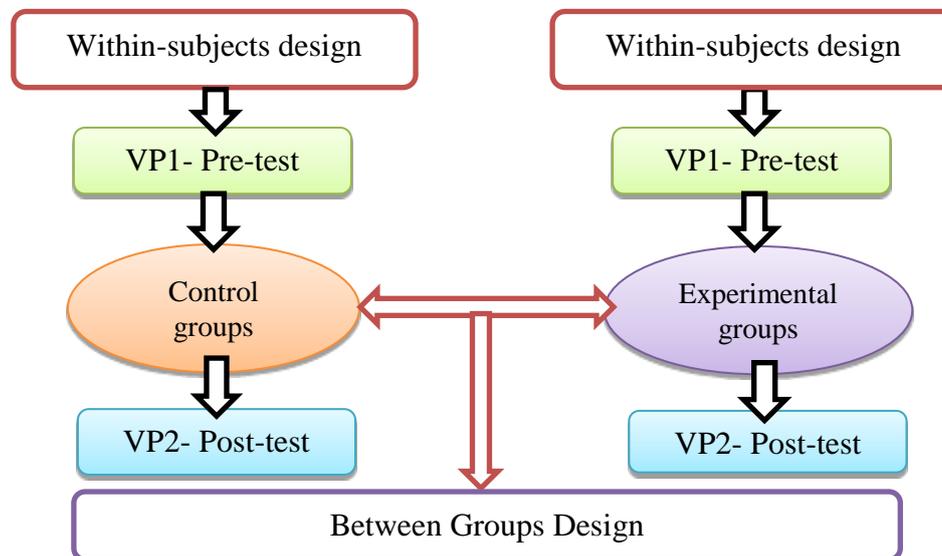


Figure 3-3 : Within-subjects and between-groups designs

3.3.1.1 Within-subjects design

It is worth noting that the process of conducting research and designing a study involves establishing methods or designs for data collection. In order to ensure suitable methods two common designs have been applied in this experiment: within-subjects design and between-groups design. A within-subjects design was applied to all participants whose situations were similar, and their knowledge was tested twice, knowledge in pre-test and learning outcomes in post-test. A within-subjects design is one in which the same individuals participate in all of the experimental conditions – that is, measures are repeated from the same people, thereby examining the differences within the subjects (Jackson, 2015).

This method reduces any error variance associated with individual differences (Gravetter and Forzano, 2011). This experiment was applied to four groups, beginning with the control groups which consisted of a set of students who were presented with the e-lecture. The conditions of all participants in these groups were the same and they were given pre-tests as well as post-tests to check their knowledge before and learning outcomes after the experiment

was applied (see Appendix C). A further set of students representing the experimental groups received the lecture via a PC lab where they used the IELTS. For data collection each group was measured by within-subjects methods to test the independent variables for all participants in each group separately, as explained in Figure 3.4. This design is called repeated measure because all participants have the same treatment.

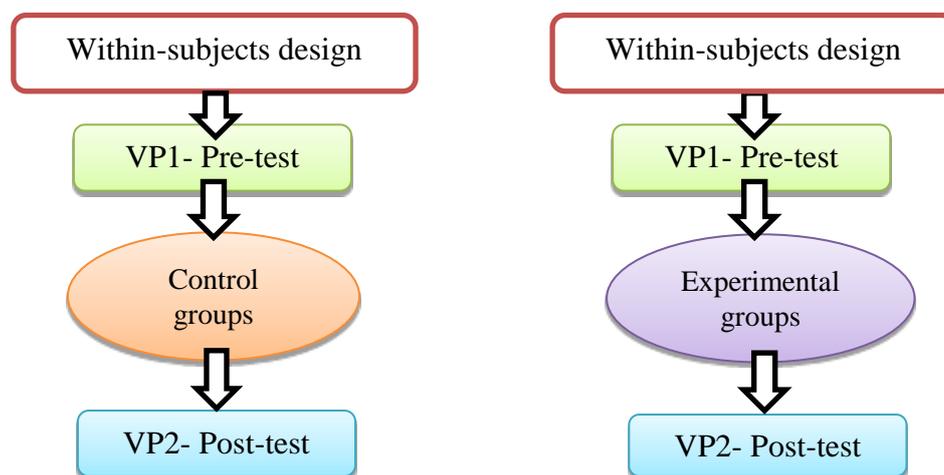


Figure 3-4 : Within-subjects design for both groups separately

3.3.1.2 Between-groups design

In order to test the research hypothesis another method was applied in this experiment which is between-groups design, as shown in Figure 3.5. A between-groups design is one that can be used if participation in one condition makes it impossible for a participant to take part in another (Field and Hole, 2003). A between-groups design is an experimental design in which different groups are assigned to the different conditions in the experiment. That is, the control group and the experimental group will consist of different people. The point of the study then is to examine any observed differences between the groups.

This method is suitable for comparing between the e-lecture group and the IELTS group, as well as for comparing between experimental sub groups who worked under different conditions as shown in Figure 3.5. The participants were selected randomly for these groups to make sure the confounding variables were equally distributed within all conditions. Random distribution of students between groups ensures that any differences between the groups are the consequence of chance and not of systematic bias (Bernard, 2011). Furthermore, the use of this method in this research means the control groups' performance cannot affect the experimental groups' performance, because each group has different

conditions or independent variables. Condition IVI1 is a Popup action which was given to experimental groups B1 and C1 (Popup action is an interactive question that appears randomly when the video clip is running. It is designed to make sure the students are following the content of the lecture and concentrating carefully). While condition IVI2 is a Click action which was given to experimental groups B2 and C2 (The technique of the Click action differs from that of the Popup action which appears then disappears. For the Click action, the lecturer uploads the video clip and identifies its duration and subtopic). The independent variable has been measured for all participants and both groups. Therefore this method is based on an independent measurement.

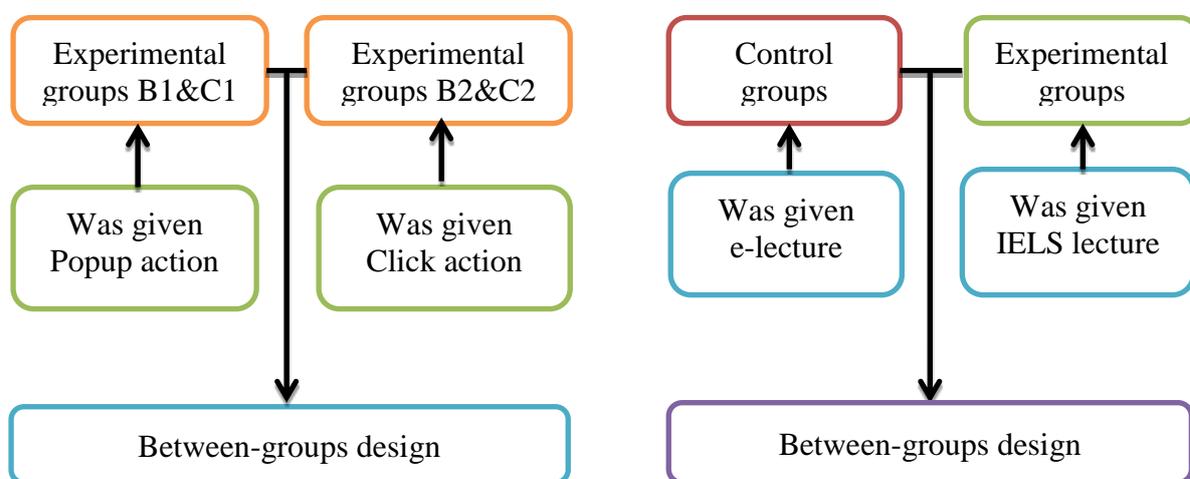


Figure 3-5 : Between-groups design

3.3.2 Variables

The aim of this experiment is to examine the validity of the research hypotheses; therefore, in order to maximise confidence in this research it is important to consider all relevant variables to establish whether they are a cause or an effect. Based on the study design in this experiment there are some independent and dependent variables. Taking the variables into account for this study they influenced the outcomes of the experiment. There is a very close relationship between the independent variables and dependent variables in this research.

3.3.2.1 Independent variables

This experiment was built and designed to assess a new lecturing system, therefore there are two main independent variables. The first independent variable is the e-lecture (IVE) which was applied to the A groups, while the IELTS lecture (IVI) is the second independent variable applied for the B and C groups. The IVI variable was divided into two sub independent variables or conditions, IVI1 which is Popup action and IVI2 which is Click action as shown in Figure 3.6.

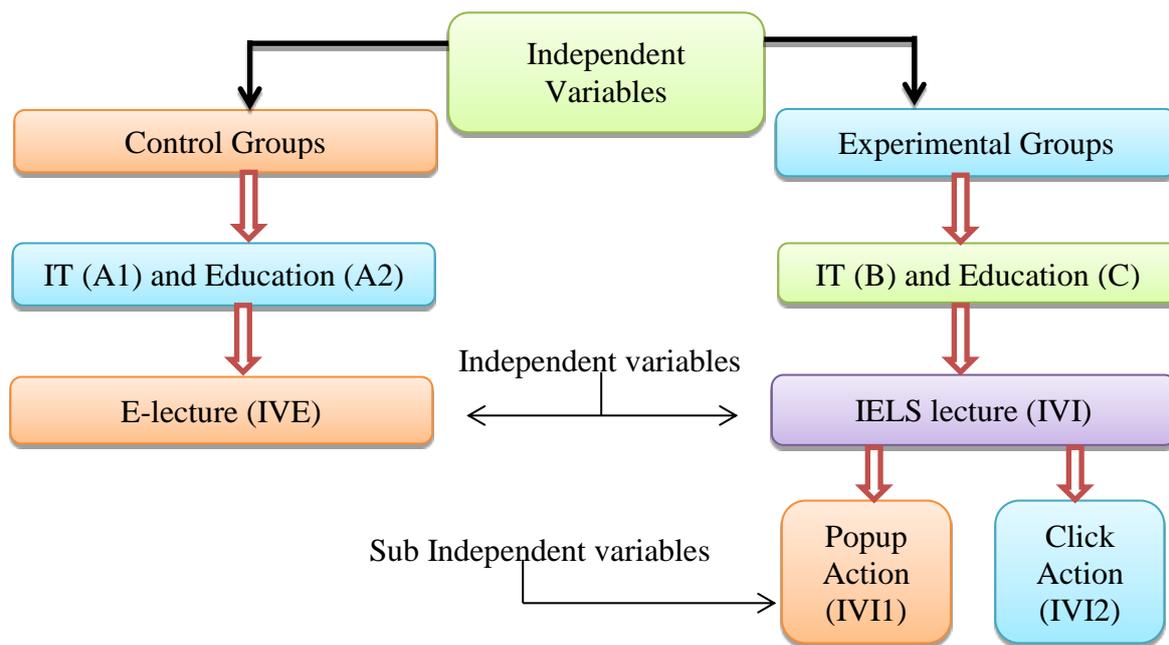


Figure 3-6 : Independent and sub independent variables

To test the research null hypothesis and with regards to the participants from two departments, IT and Education, according to these conditions, groups B (IT) and C (Education) were divided into four further groups, B1, B2, C1 and C2. B1 and C1 worked under condition IVI1 (Popup Action), while B2 and C2 worked under condition IVI2 (Click Action). The B and C groups worked under sub independent variables so that the experiment results could be checked before and after the conditions.

3.3.2.2 Dependent variables

In this experiment the dependent variables can be derived from the independent variables. For instance the independent variable used the proposed system (IELS) to examine dependent variables such as IELS accessibility, IELS usability, IELS interactivity, IELS learnability,

IELS communication, IELS satisfaction, the students' learning outcomes, interaction with lecture content and their effect on exchange of information. Figure 3.7 shows the dependent variables.

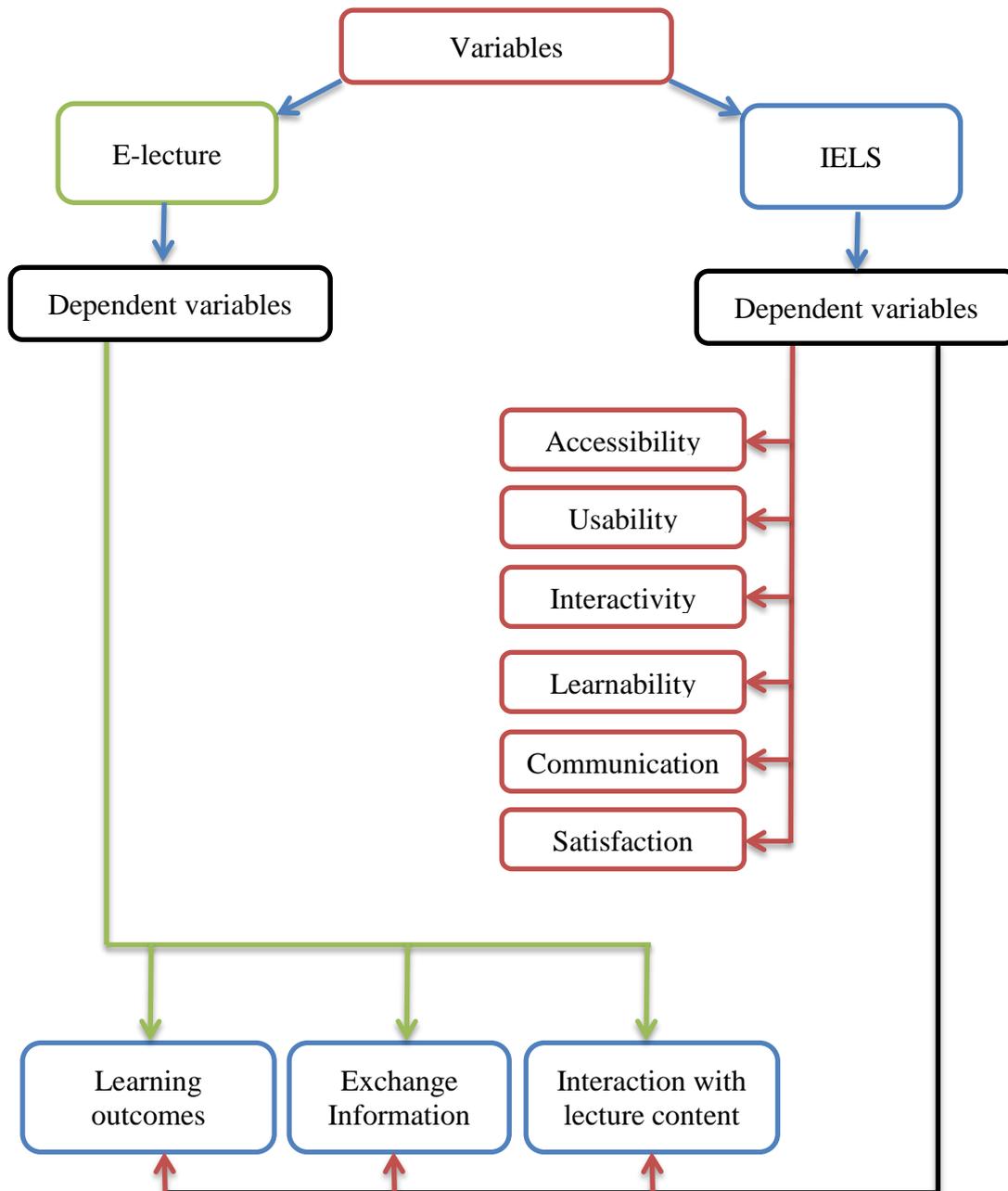


Figure 3-7 : Dependent variables

Four groups participated in this experiment, the control groups and the experimental groups; the A, B and C groups were given two tests pre-tests (DVP1) to check knowledge and post-

tests (DVP2) to check the learning outcomes. Figure 3.8 show how to measure the dependent variables.

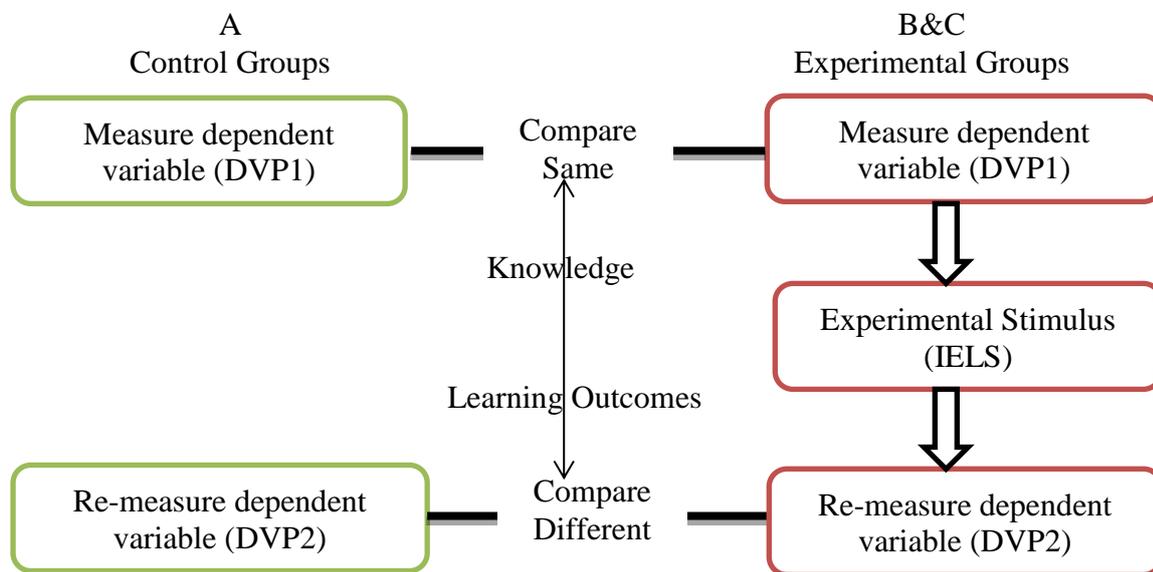


Figure 3-8 : Measure Dependent variables

3.3.3 IELS Functions and Attributes

There are two main users in this system, students and lecturers. Users' needs and requirements were taken into consideration when building the IELS, which was designed for delivering lectures, to examine and explore the efficiency of this system. The main reason for conducting this experiment was to discover what effects can be achieved by applying the independent variables stated in Subsection 3.3.2.1 and make comparisons between them in different conditions.

Independent variables were tested by carrying out the experiment and a comparing the results, based on six research dimensions, to find out what result could be reflected on dependent variables when testing the research null hypotheses by examining the system's efficiency and its effectiveness.

System performance is a major element of this research. It indicates some of the functions and features of the IELS that can be used, and checks its validity; these include: easy access,

easy use, interfaces, easy to learn from, navigations, accounts, lecture duration, video clip actions, and messages. Based upon the literature review and the preliminary study these features and functions were combined to form the research dimensions in order to examine the independent variables and sub independent variables.

The research dimensions are accessibility, usability, interactivity, learnability, communication and satisfaction. They will help to assess the independent variables, and answer some of the research questions respectively (Q5, Q6, Q7, Q8, Q9 and Q10) that have been presented in Chapter 1.

3.3.3.1 IELS accessibility

This dimension is indicated in research question Q5 (*Does accessibility differ between the IELS groups?*). It consists of a number of system features such as: register with the system, sign in, sign out, and accessibility of the system. These features will be tested and examined to answer Q5; to help to answer this question it has been divided into sub questions:

- *Does accessibility to the IELS differ between the IT student groups?*
- *Does accessibility to the IELS differ between the Education student groups?*
- *Does accessibility to the IELS differ between the IT and Education student groups?*

3.3.3.2 IELS usability

When talking about the usability of IELS it is necessary to know whether or not the system is easy to use, whether or not the system offers easy navigation, and the level of editing the personal user settings. It is also important to establish how the research will provide evidence of the reliability of the proposed system, how the system will enhance the user's ability to view the lecture content for learning, as well as who will benefit from this system. All these aspects will be covered and tested to answer Q6 (*Does usability differ between the IELS groups?*). This question has been divided into three sub questions as follows:

- *Does usability of the IELS differ between the IT student groups?*
- *Does usability of the IELS differ between the Education student groups?*
- *Does usability of the IELS differ between the IT and Education student groups?*

3.3.3.3 IELS interactivity

One of the major reasons for creating this system was to improve the level of user interactivity. Q7 covers the aspect of interactivity in this research and investigates how the

IELS fosters students' ability to use it and how it enhances their engagement compared to the e-lecture. (*Does interactivity differ between IELS groups?*). This question has been divided into three sub questions:

- *Does interactivity with the IELS differ between the IT student groups?*
- *Does interactivity with the IELS differ between the Education student groups?*
- *Does interactivity with the IELS differ between the IT and Education student groups?*

3.3.3.4 IELS learnability

The IELS has some features that enhance the learning process: it makes the delivery of lectures easy; it offers the option of presenting short clips; and it can be accessed at any time. Therefore Q8 asks about the level of ease for students in using this system, as well as how IELS can facilitate lecturing compared to the e-lecture (*Does learnability differ between the IELS groups?*). To answer this question it has been divided into three sub questions:

- *Does learnability from the IELS differ between the IT student groups?*
- *Does learnability from the IELS differ between the Education student groups?*
- *Does learnability from the IELS differ between the IT and Education student groups?*

3.3.3.5 IELS communication

IELS might offer a rich environment for communication between students as well as between students and lecturers. Some IELS features were examined to assess ease of communication between IELS users, such as ease of communication with any user, ease of obtaining feedback, ease of sending messages and ease of chatting. Q9 will reveal the level of communication that can be reached with IELS (*Does communication differ between the IELS groups?*). This question has been divided into three sub questions as follows:

- *Does users' communication when using the IELS differ between the IT student groups?*
- *Does users' communication when using the IELS differ between the Education student groups?*
- *Does users' communication when using the IELS differ between the IT and Education student groups?*

3.3.3.6 IELTS satisfaction

User satisfaction reflects the level of IELTS success; it also shows how users enjoyed using the IELTS. In addition, in order to answer Q10, it shows how involved they were in the content and the features of the system such as IELTS interface designs, colours, multimedia, video clip duration (*Does satisfaction differ between users in the IELTS group?*). This question has been divided into three sub questions as follows:

- *Does satisfaction with the IELTS differ between the IT student groups?*
- *Does satisfaction with the IELTS differ between the Education student groups?*
- *Does satisfaction with the IELTS differ between the IT and Education student groups?*

3.3.4 Null Hypotheses

A null hypothesis states that there are no differences between sets of data and checks the variances between variables (Kamrani and Nasr, 2008), therefore to find the significant differences null hypotheses were formulated. According to Sheskin (2003) null hypotheses might be rejected or fail to be rejected, according to a specific test that will be conducted to check level of significance (p value). A common level of p value (0.05) will be considered to test and examine the null hypotheses if the $p \leq 0.05$ the null hypothesis will be rejected while if the $p > 0.05$ the null hypothesis will fail to be rejected. The research questions Q5 to Q13 and their sub questions will be translated into null hypotheses as follows:

Q5- Does accessibility differ between the IELTS groups?

NH 5.1 There is no difference between the means of accessibility from the perspective of the IT student groups

NH 5.2 There is no difference between the means of accessibility from the perspective of the Education student groups

NH5.3 There is no difference between the means of accessibility from the perspective of the IT and Education student groups

NH5.4 There is no difference between the means of accessibility from the perspective of the IT and Education lecturer groups

Q6- Does usability differ between the IELTS groups?

NH6.1 There is no difference between the means of usability from the perspective of the IT student groups

NH6.2 There is no difference between the means of usability from the perspective of the Education student groups

NH6.3 There is no difference between the means of usability from the perspective of the IT and Education student groups

NH6.4 There is no difference between the means of usability from the perspective of the IT and Education lecturer groups

Q7 -Does interactivity differ between the IELTS groups?

NH7.1 There is no difference between the means of interactivity from the perspective of the IT student groups

NH7.2 There is no difference between the means of interactivity from the perspective of the Education student groups

NH7.3 There is no difference between the means of interactivity from the perspective of the IT and Education student groups

NH7.4 There is no difference between the means of interactivity from the perspective of the IT and Education lecturer groups

Q8- Does learnability differ between the IELTS groups?

NH8.1 There is no difference between the means of learnability from the perspective of the IT student groups

NH8.2 There is no difference between the means of learnability from the perspective of the Education student groups

NH8.3 There is no difference between the means of learnability from the perspective of the IT and Education student groups

NH8.4 There is no difference between the means of learnability from the perspective

of the IT and Education lecturer groups

Q9- Does communication differ between the IELTS groups?

NH9.1 There is no difference between the means of communication from the perspective of the IT student groups

NH9.2 There is no difference between the means of communication from the perspective of the Education student groups

NH9.3 There is no difference between the means of communication from the perspective of the IT and Education student groups

NH9.4 There is no difference between the means of communication from the perspective of the IT and Education lecturer groups

Q10- Does satisfaction differ between the IELTS groups?

NH10.1 There is no difference between the means of satisfaction from the perspective of the IT student groups

NH10.2 There is no difference between the means of satisfaction from the perspective of the Education student groups

NH10.3 There is no difference between the means of satisfaction from the perspective of the IT and Education student groups

NH10.4 There is no difference between the means of satisfaction from the perspective of the IT and Education lecturer groups

Q11-Do learning outcomes differ between the e-lecture groups and the IELTS groups?

NH11.1 There is no difference between the means of learning outcomes of e-lecture and IELTS for the IT student groups

NH11.2 There is no difference between the means of learning outcomes of e-lecture and IELTS for the Education student groups

Q12. Does exchange of information differ between the e-lecture groups and the IELTS groups?

NH12.1 There is no difference between the means of exchange of information between the IELTS IT student groups

NH12.2 There is no difference between the means of exchange of information of e-lecture and IELTS for the IT student groups

NH12.3 There is no difference between the means of exchange of information between the IELTS Education student groups

NH12.4 There is no difference between the means of exchange of information between the e-lecture and the IELTS for the Education student groups

Q13. Does student interaction differ between the e-lecture groups and the IELTS groups?

NH13.1 There is no difference between the means of student interaction with lecture content of the e-lecture and IELTS for the IT student groups

NH13.2 There is no difference between the means of student interaction with lecture content of the e-lecture and IELTS for the Education student groups

3.4 Data Analysis Methods

Mixed methods were conducted to collect and analyse data. In this research the nature of the data required qualitative and quantitative approaches to be identified. Many different types of data were collected, for example students' interaction, learning outcomes and student satisfaction. These methods offered a comprehensive understanding of the many complex processes in the experiment. Although there are differences between the quantitative and qualitative approaches they can be mixed or integrated. Combined strategies are the most advanced in learning research and they may be the most appropriate here as they can provide true results in complex learning processes (Condelli and Wrigley, 2004). In order to examine

the research null hypotheses and variables, statistical tests have been conducted such as parametric and nonparametric tests.

3.5 Data Collection

A fundamental and highly important step for evaluating the IELS is to describe how the data sources were analysed. The reason for choosing the participants in this experiment will be explained. In addition, the way the data was gathered and extracted using questionnaires, pre-test, post-test and system record will be shown, as will the stages of the collection process for the experiment. It is important in research to choose and apply accurate and appropriate data collection instruments, because this will directly affect the research findings (Kimberlin and Winterstein, 2008). A number of data collection instruments were implemented during this experiment. For instance, preliminary and main questionnaires were distributed to participants, lecturers and students. Pre-tests and post-tests, another data resource, were carried out to enable assessment of the students' learning outcomes for both the experimental group and the control group (see Appendix C). In addition, system records determined what level of interactivity and exchange of information could be extracted. The data collection provided information regarding the use of the IELS and showed how the users were engaged within the context of the system.

3.5.1 Preliminary Study

According to experiment procedures a preliminary study was conducted to identify the current situation of lecturing at King Abdulaziz University, to ascertain how satisfactory the level of lecture delivery is, as well as to discover the level of the students' and lecturers' computing skills. Section 3.6.7 shows all participants in the preliminary study according to their demographic.

A preliminary questionnaire was prepared and approved. As the nature of this experiment and the background of the participants involves the Arabic language, this was translated by the researcher and approved by a friend. The preliminary questionnaires (Appendix B) were uploaded to Google Drive at URL (<http://goo.gl/B8BMYV>) for the lecturers and for the students. Preliminary questionnaires were sent to the staff in the Faculty of Science and Arts, to be distributed to the target participants. Two preliminary questionnaires (Form PQ1 and Form PQ2) were constructed (See Appendix B), one for the lecturers and the other for the

undergraduate students. A total of 33 students and 14 lecturers participated in this study from the following departments: Arabic (Ar), Education (Ed), Mathematics (Mh), Information Technology (IT), Physics (Ph), Biology (Bi), Business (Bs) and English (En) to answer the questionnaire.

3.5.2 Main Study

Gathering data for the main study is a crucial stage in conducting the experiment. This stage consists of several data sources that were extracted from the main study and in this experiment two groups were involved, the control group and the experimental group. Section 3.6.7 maps the participants' demographic in this study. Sixty-four volunteer students participated and they were randomly divided into two groups; the first group attended the e-lecture (32 students) while the second group used the IELTS (32). Ten volunteer lecturers were also asked to participate and supervise in the experiment; two of them conducted the e-lecture while eight worked on the IELTS.

3.5.2.1 Questionnaire

Based on the six dimensions that were reviewed and described in Chapter 2, and on the preliminary study discussed in Chapter 4, two formats of questionnaire, Form MQ1 for students and Form MQ2 for lecturers (see Appendix C) were designed, according to the Likert scale, then developed and distributed to the subjects to discover their attitudes to their use of the IELTS. The Likert scale was introduced by Rensis Likert in 1932, and is most widely used in survey research to measure observable attributes in various social science measurement areas (Li, 2013). Each questionnaire included three parts: the first to find out the participants' demographic; the second includes thirty two items that represent the research dimensions, designed according to the Likert scale ranging from 5 = Outstanding, 4 = Good, 3 = Satisfactory, 2 = Poor, to 1 = Unsatisfactory, to discover their attitudes using the IELTS; and the third was a qualitative method with open questions, to obtain participants' opinions and suggestions regarding the IELTS.

3.5.2.2 Participants

For the e-lecture 32 students attended 16 for IT e-lecture and 16 for Education e-lecture. Also a total of 32 students (eight male and eight female from the IT department and eight male and

eight female from the Education department) participated in the experiment. There were two parts to the experiment. In the first part the IT group was selected randomly then divided into two sub-groups: group B1 (eight students) who used the IELTS via Popup action and group B2 (eight students) who used the IELTS via Click action. The sample of student were drawn from level 3 and level 4 who had no experience about the delivered lecture and were not enrolled in this module before. In the second part the Education group was also randomly divided into two sub-groups; group C1 (eight students) who used the IELTS via Popup action and group C2 (eight students) who used the IELTS via Click action.

3.6 Analysis Framework

Analysis framework comprises of statistical tables that show the data that can be extracted in this research. Some data is extracted from the preliminary questionnaire and some from the main questionnaire. Statistical package SPSS 20 was used to conduct the analysis and a number of tests were used to analyse the data collected from research instruments data. Both parametric and nonparametric tests were conducted. Figure 3.9 shows the analysis framework according to statistical SPSS tests.

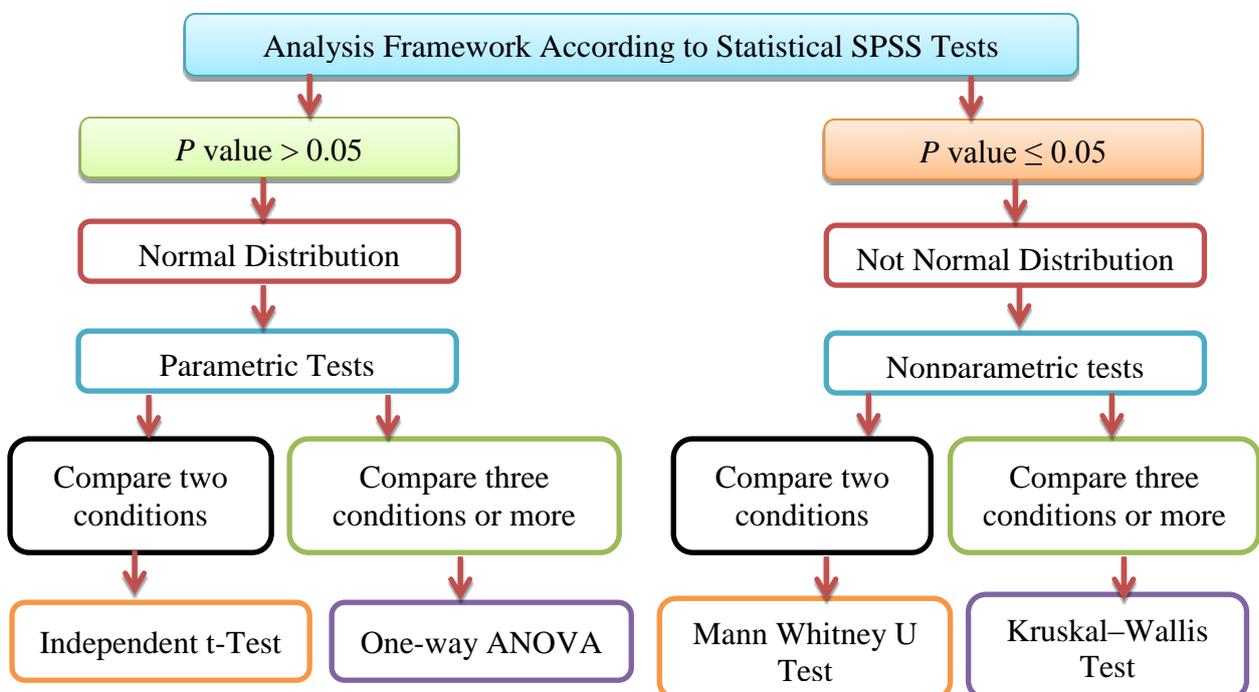


Figure 3-9: Analysis framework according to statistical SPSS tests

To test the equality of variances, both parametric and nonparametric tests were used. Parametric tests (Independent t-test and one-way ANOVA) are more appropriate for a small range of data and can be used when the data is normally distributed. According to Robson (1994) nonparametric tests (Mann-Whitney U, Kruskal–Wallis) can be used on a wider range of data types therefore they require fewer assumptions. If the data is not normally distributed nonparametric tests must be used (Neideen and Brasel, 2007). Figure 3.10 shows, in more detail, how the research questions were represented in the preliminary study and the main study.

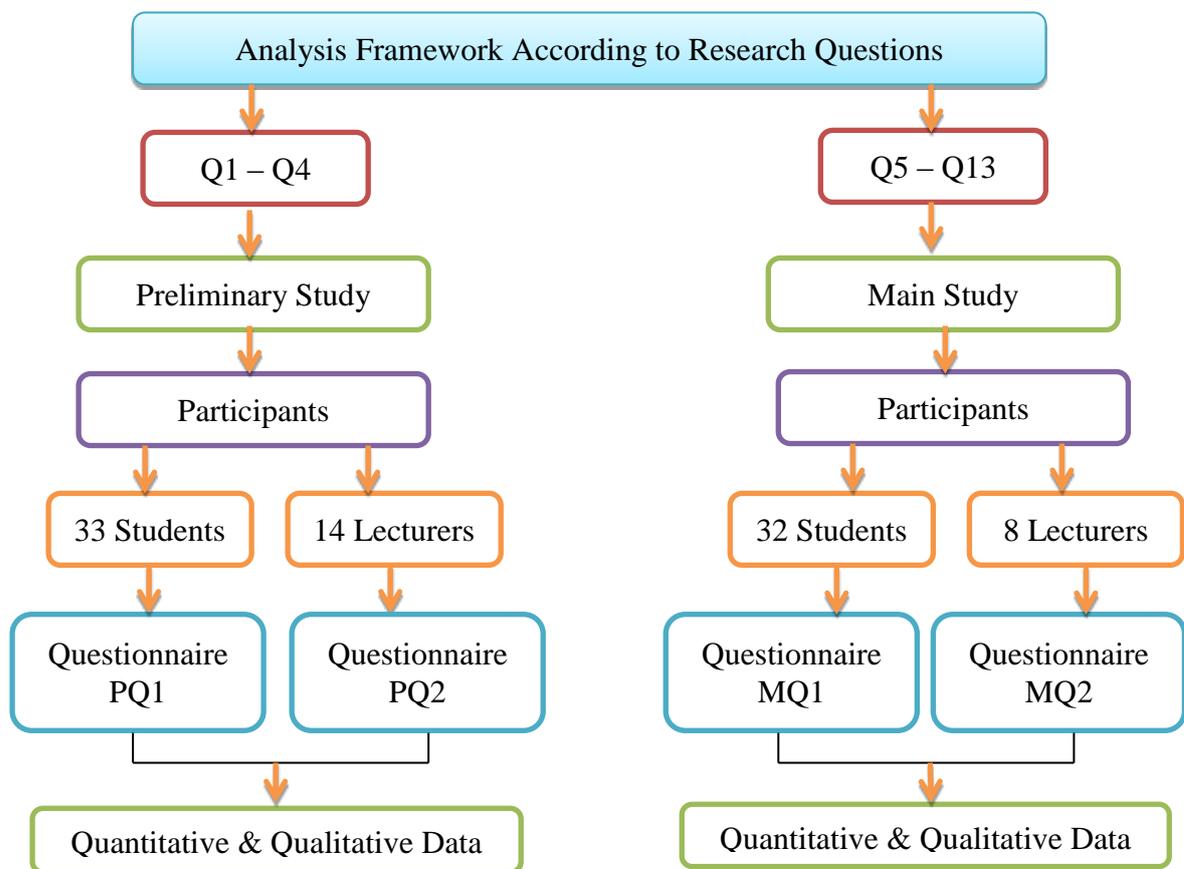


Figure 3-10 : Analysis framework according to research questions

3.6.1 Shapiro-Wilk Test

To determine which test should be used to measure statistical significance between variables or conditions, normal distribution is applied, therefore the *Shapiro-Wilk test* was used. The *Shapiro-Wilk Test* is more appropriate for small sample sizes and was originally restricted to sample sizes of less than 50 (Razali and Wah, 2011). If the ($p \geq 0.05$) from distribution this means there is no statistical significance from normal distribution and in this case a

parametric test will be used, such as the *Independent t-test* or *One-way ANOVA*. There is statistical significance if ($p < 0.05$) from the data distribution and therefore the *Mann-Whitney U test* or *Kruskal–Wallis test* was used. According to this concept Figure 3.8 shows the analysis framework of the research data.

3.6.2 Independent T-test / One Way ANOVA

Independent t-test is a parametric test that is used to compare between the means of two variables that have different conditions, and to find the significant differences between them. This test must be used when the data is normally distributed to compare between two conditions, while one-way ANOVA is a procedure for testing a hypothesis to compare the means of three or more conditions, (Lazar, Feng and Hochheiser, 2010).

3.6.3 Mann-Whitney U Test / Kruskal-Wallis Test

The Mann-Whitney U test is a nonparametric test used to compare two variables for which the data is not normally distributed, as well as to check whether there are significant differences between two conditions. The Kruskal–Wallis test is performed to compare between three or more conditions (Robson, 1994).

3.6.4 Paired Sample T-test

Paired t-test is a parametric test that is used to find the differences for the same group with different conditions. The common use of paired sample is to assess changes that take place between two points in time within one group (Rubin, 2009). For example, students in experiment group A were given a pre-test to examine their knowledge and then they were taught using the different lecture types; afterwards they were given the same exam as a post-test to check their learning outcomes after the changed condition. This test measured the significant level for this group for both conditions.

3.6.5 Principal Component Analysis

Principal component analysis is a platform to conduct factor analysis in order to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables (Weber, Chandler and Finley, 2011). Factor analysis is often used in data reduction to identify a small number of factors that explain most of the variances observed in a much larger number of manifest variables (Brewster and University, 2006). The theory

behind using factor analysis is to determine the relationship and variances among variables, as well as to help group together variables that have similar characteristics. It is also used here to test the set of items and how they measure a specific dimension. It is a reduction technique method to re-express multivariate data with fewer dimensions. In addition, it provides construct validity evidence of self-reporting scale (Nunnally, 1978).

3.6.6 Cronbach's Alpha Test

Cronbach's alpha is the most common method of testing internal consistency reliability coefficients (Drost *et.al*, 2011). It ranges in value from 0 (when the true score is not measured at all and there is only an error component) to 1 (when all items measure only the true score and there is no error component) (Cronbach, 1951). The higher the value of alpha, the more reliable the scale is. As a rule of thumb, alpha should be at least 0.7 (De Vaus, 2002).

To check the reliability of data collected from questionnaire (MQ1) Cronbach's alpha was used to test the means of the student groups and it was found to be 0.879 for the IT student groups and 0.913 for the Education student groups which indicates that the internal consistency is very reliable as shown in Table 3.1.

IT student groups			Education student groups		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.879	0.874	32	0.913	0.912	32

Table 3-1 : Reliability test for Questionnaires (MQ1)

Table 3.2 shows there is a high reliability of internal consistency for the data extracted from questionnaire (MQ2). The result of the Cronbach test is 0.833 for the IT lecturer group and 0.986 for the Education lecturer group.

IT lecturer group			Education lecturer group		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.833	0.813	32	0.986	0.987	32

Table 3-2 : Reliability test for Questionnaires (MQ2)

3.6.7 Demographic Data Analysis

The following tables show the number of participants from students and lecturers, and their demographic, according to the main study and the preliminary study. Table 3.3 shows student demographic in the preliminary study according to their department, university level and grade point average.

Gender		Department								University Level				Grade Point Average			
		IT	Ed	Ph	En	Bi	Mh	Ar	Bs	1	2	3	4	1<2	2<3	3<4	4≤5
Female	18	5	4	3	1	2	0	1	2	4	5	4	5	2	6	7	2
Male	15	2	6	1	1	3	1	0	1	3	1	7	4	1	0	8	7
Sum	33	7	10	4	2	5	1	1	3	7	6	11	9	3	6	15	9

Table 3-3 : Students' demographic (PQ1)

Table 3.4 shows the student demographic in the main study according to their department, university level and grade point average.

Gender	Department		University Level				Grade Point Average			
	Education	IT	1	2	3	4	1<2	2<3	3<4	4 ≤ 5
Male	8	8	0	0	11	5	0	2	7	7
Female	8	8	0	0	10	6	0	1	6	9
TOTAL	16	16	0	0	21	11	0	3	13	16

Table 3-4 : Students' demographics (MQ1)

Table 3.5 shows the number of lecturers according to their demographic data in the preliminary study.

Gender	Department					Years of Experience				Computer Skills			
	Ph	En	Mh	Bi	IT	1-5	6-10	11-20	More than 20	Satisfied	Good	very god	Excellent
Female	1	1	0	0	0	2	0	0	0	1	0	0	1
Male	2	1	1	2	6	4	5	2	1	1	3	6	2

Table 3-5 : Lecturers' demographic questionnaire (PQ2)

Table 3.6 shows the number of lecturers according to their department, years of experience and proficiency in computer skills data in the main study.

Gender	Department						Years of Expertise				Computer Skills			
	Ph	Ed	Ch	M	B	IT	1-5	6-10	11-20	More than 20	Satisfied	Good	very god	Excellent
Female	0	2	0	0	0	2	0	2	1	1	0	1	1	2
Male	0	3	0	0	0	3	1	1	2	2	0	1	3	2

Table 3-6 : Lecturer demographic (MQ2)

Table 3.7 shows the number of students who participated in the experiment.

Participants: Students	Preliminary Questionnaire	Main Questionnaire	Using e-lecture	Using IELS
Number of females	18	16	16	16
Number of males	15	16	16	16

Table 3-7 : Number of students who participated in the experiment

Table 3.8 shows the number of lecturer who participated in the experiment.

Participants: Lecturers	Preliminary Questionnaire	Main Questionnaire	Using e-lecture	Using IELS
Number of females	2	4	0	4
Number of males	12	4	2	4

Table 3-8 : Number of lecturers who participated in the experiment

3.7 Experiment Protocol

This experiment was conducted at KAU in Saudi Arabia, and on arriving in Saudi Arabia to carry out the experiment certain procedures were necessary conducted such as experiment timetable (See Appendix A). Figure 3.11 shows the experiment map. To carry out the experiment the following steps were implemented.

- 1- Met with the staff and decided which module would be most suitable for IELTS.
- 2- Prepared the room and lab for the experiment.
- 3- Consent forms were filled in by all the participants (see Appendix A)
- 4- Made preparations with the lecturer responsible for teaching the chosen module then scheduled with them the date the e-lecture would be delivered.
- 5- Divided the students randomly into two groups, A groups (A1 and A2) and B and C groups (B1 and B2) and (C1 and C2).
- 6- Asked A groups to attend the e-lecture.
- 7- The A groups were given a pre-test which examined their prior knowledge of the lecture content.
- 8- The lecture was presented to the A groups in the e-lecture way (Student attend the class and listen to the lecturer who present the topic lecture using PowerPoints slides) and a video recording of the lecture was made.
- 9- The A groups were given a post-test when they finished the e-lecture in order to check their learning outcomes.
- 10- A number of volunteer lecturers were trained in the IELTS and shown the system's features and how could they manage their work.
- 11- The researcher divided the recorded lecture into many short clips according to the lecture contents, and added subtitles with the help of staff.
- 12- A short demo was run of the system in the faculty lab for the B & C groups, the experimental group; they were then trained in the IELTS and shown its features and told when the experiment would be conducted.
- 13- The B & C groups were given a pre-test which examined their prior knowledge of the lecture content.
- 14- The lecture was presented to the B & C groups in the lab using the IELTS.
- 15- Lecturers worked with their students, saw their credit records from the system and exchanged messages with them.
- 16- The lecturers gave their opinion and filled in the main questionnaire.
- 17- The B & C groups were given a post-test when using the IELTS in order to check their learning outcomes.
- 18- The B & C groups were given the questionnaires to provide feedback and their perspectives when they used the IELTS.
- 19- The researcher mentored all sessions and provided help when needed.

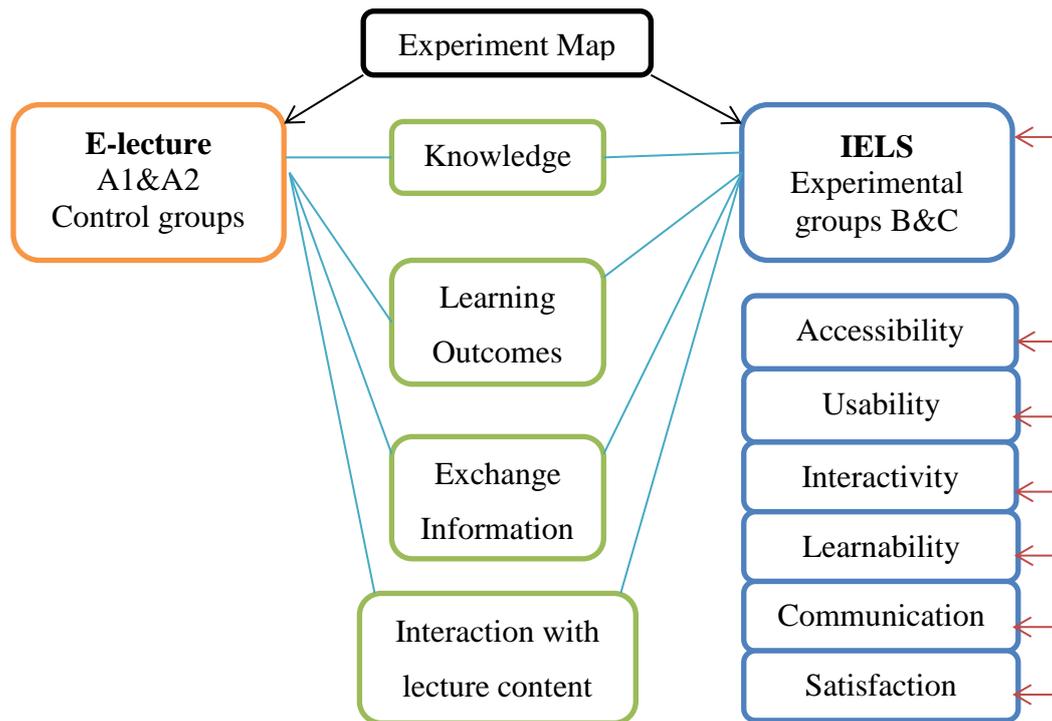


Figure 3-11 : Experiment map

3.8 Research Ethics

With regard to ethics, research may include various interested parties, for instance funders, sponsors or society at large. It is important to remember that, when conducting research which requires a number of participants there is a sense of dignity and worth for everyone involved in the research process (Oliver, 2010). The ethical issues include the nature of the research and the place where the experiment is carried out. Some people do not like to provide certain information such as their name, age, expertise or job. When participants were asked to take part in this research, particularly in the preliminary questionnaire, it was stated at the top of the questionnaire that all information and data acquired would remain anonymous in order to re-assure the participants and encourage them to submit their responses honestly and openly. Written consent was obtained and signed by the researcher and the consenting participants (Appendix A). Before conducting this experiment approval was obtained from the Ethics Committee of the School of Engineering and Computing Sciences at Durham University (Appendix A). All participants were clearly informed of their rights. They were also informed that they could withdraw from the experiment at any time.

3.9 Threats to Validity

The nature of this research required the involvement of a wide range of stakeholders. The experiment was carried out at King Abdulaziz University in Saudi Arabia, in the Faculty of Science and Art in Kulais. Two months before the commencement of the experiment the faculty was moved to a new location on the outskirts of Jeddah. Saudi Arabia is a developing country with insufficient infrastructure for communication and internet services. As IELS was uploaded on the URL www.ielsystem.com, the research required a smooth and easy internet connection.

Throughout this experiment, the following threats to validity were possible. As Saudi Arabia is a Muslim country it is difficult to have both male and female participants together, therefore this experiment was carried out with male participants in the first implementation. Females were sent the link to system, but their participation was still difficult to monitor record or picture in the same way as with male participants.

3.10 Conclusion

In conclusion, as well as setting out the research questions rewriting them into sub questions then translating them into null hypotheses, the research methodology has 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. Analysis framework has been specified and data sources for this system have been described. In addition, experiment protocol has been explained and research ethics have been presented. Finally, in this chapter threats to validity have been discussed.

The following chapter will analyse the preliminary study that was conducted in an effort to explain the extent to which IELS would enhance lecturing at KAU. It will provide an overview of the current situation regarding lecturing at KAU as well as the desired situation. It will also identify and then analyse users' requirements and their needs. Finally it will investigate the preliminary questionnaire for participants, lecturers and students and analyse their responses.

4

Preliminary Study

4.1 Introduction

A preliminary study is an initial survey of issues related to a suggested quality review or evaluation (Harvey, 2004). A significant reason for applying this study at KAU is the need to determine what the current situation of delivering lectures there is, as well as to discover the features required to deliver successful lectures, and to identify what technologies could be developed and used to enhance the lecturing process at KAU. Therefore, two types of user were involved in the preliminary study, undergraduate students and lecturers, to ascertain the technologies that might be used to support their interactivity and communication within the lecturing process. Two different types of questionnaire (see Appendix B) were distributed to the participants to discover their attitudes with regard to developing the lecturing process. The preliminary study found that there is a need to develop the lecturing system and shift it from the traditional and e-lecture style to a greater use of technology.

4.2 Preliminary Study Terms

There are some terms that were specified and used in this study to measure the perspective of participants about their experience they are defined as follow:

Live Lecture: Lecture can be seen electronically at the same time when lecturer is talking. This kind of lecture is usually delivered to female students from a distance class when the lecturer is a male.

Online Lecture: Lecture can be seen electronically any time without attendance at the class.

Interactive Lecture: Lecture can be seen in some application that requires some interaction with its content from learners.

Recorded Lecture: Lecture can be saved in some storage for example Hard disc, CDs, Flash memory or can be recorded in a tape then can be seen any time learner wants to.

4.3 Research Questions

This chapter focuses on the preliminary study of the interactive electronic lecture system (IELS) to ascertain whether the system could support the lecturing process at King Abdulaziz University (KAU). In addition, it aims to discover the feasibility of the study and whether it could be applied in such an environment as KAU. Furthermore, it compares the current situation for delivering lectures and answers some of the research questions that were addressed in Chapter 1, such as Q1, Q2, Q3, and Q4. The points to be discussed in this study concern: who the participants in the preliminary study are and their demographics; and the level of computer skills they have and how often they use the internet and why. The questions to be answered are:

Q1. What is the current situation regarding delivering lectures at KAU?

Q2. What is the desired situation for delivering lectures at KAU?

Q3. What learning theories could be applied within the interactive electronic lecture?

Q4. What technologies might be used to enhance interactivity in IELS?

These questions will be taken into consideration when the design of the questionnaire forms is applied, as shown in section 4.3.2.

4.4 Method

According to this study, the nature of the data which needs to be gathered requires a number of methods of data collection. Therefore this study will employ mixed methods, quantitative and qualitative, to answer the research questions. Based upon the previously-mentioned research questions, this research presents the method used to conduct the preliminary study. Mixed methods were applied to answer questions Q1 to Q4 in order to ascertain the feasibility of the study.

4.4.1 Participants

The study was divided into two groups, students and lecturers, as the end users of the IELTS. The participants were from various departments at KAU who responded to online questionnaires, as shown in Table 4.1.

Participants	Students	Lecturers
Female	18	2
Male	15	12
TOTAL	33	14

Table 4-1 : Participants' status and gender

4.4.1.1 Students

Thirty-three undergraduate students were involved in this study. The majority of participants were in their third year and 27.3% were in their fourth year as shown in Table 4.2.

University level	Frequency	Percent
First Year	7	21.2%
Second Year	6	18.2%
Third Year	11	33.3%
Fourth Year	9	27.3%
TOTAL	33	100%

Table 4-2 : Students' university level

Table 4.3 shows the students' frequency regarding students' grade point average.

GPA	Frequency	Percent
1<2	3	9.1%
2<3	6	18.2%
3<4	15	45.5%
4≤5	9	27.3%
TOTAL	33	100%

Table 4-3 : Students' GPA

Table 4.4 shows students' frequency according to department.

Department	Frequency	Percent
IT	7	21.2%
Education	10	30.3%
Physic	4	12.1%
English	2	6.1%

Biology	5	15.2%
Mathematics	1	3.0%
Arabic	1	3.0%
Business	3	9.1%
TOTAL	33	100%

Table 4-4 : Students' frequency according to department

4.4.1.2 Lecturers

Fourteen lecturers were involved in this study, two female and 12 male, from different departments. The majority of lecturers were male. In total, 42.9% of the lecturers had between one and five years' experience while 35.7% had between six and ten years' experience. Table 4.5 shows the frequency according to years of experience.

Years of expertise	Frequency	Percent
From 1 to 5	6	42.9%
From 6 to 10	5	35.7%
From 11 to 20	1	7.1%
More than 20	2	14.3%
TOTAL	14	100%

Table 4-5 : Lecturers' years of experience

Table 4.6 shows the frequency of lecturers' competency in computer skills.

Mastery of computers skills	Frequency	Percent
Satisfactory	2	14.3%
Good	3	21.4%
Very Good	5	35.7%
Excellent	4	28.6%
TOTAL	14	100%

Table 4-6 : Lecturers' competency in computer skills

Table 4.7 shows the frequency of lecturers according to department.

Department	Frequency	Percent
IT	2	14.3%
Education	4	28.6%

Physics	2	14.3%
Mathematics	2	14.3%
Business	3	21.4%
English	1	7.1%
TOTAL	14	100%

Table 4-7 : Lecturers' departments

4.4.2 Questionnaires

This study is based upon the preliminary results of a poll of students and lecturers to identify the best method of delivering lectures in their college. It also addresses how easy the learning process is made for them currently. In order to identify the requirements and the needs for the development of new lecturing systems in the future, online questionnaires were sent out to lecturers and students.

To answer the study research questions, two forms of the questionnaire were prepared: Form PQ1 for students and Form PQ2 for lecturers. Each questionnaire consisted of three parts: the first part included the demographic characteristics of the study sample such as gender, department, university level, grade average point, years of experience and mastery of computer skills; the second part aimed to discover who was eligible and qualified to participate in the study; the third part was about the importance of the current study and its feasibility and the possibility of its implementation. These forms are shown in Appendix B.

4.5 Results Analysis

This section presents the results produced by analysing the data gathered from the questionnaire in Form PQ1 and Form PQ2.

4.5.1 Results Extracted from Form PQ1

Form PQ1 (Appendix B) was completed by 18 female and 15 male students. Three major points were taken into consideration when designing the questionnaire. The first one was the demographic of participants as described in detail in Section 4.3.2 in this chapter. The second part includes two questions, Q1 and Q2, that show who is qualified to participate in this study. The third part includes questions Q3 to Q11, the aim of which was to discover

students' attitudes toward some issues with regard to the delivery of lectures in their college and their preference.

Q1- How often do you usually use the internet for learning?

The possible answers to this question were: always, often, sometimes, never. This question was included to see how the students rated their use of the internet for learning. The results are shown in Table 4.8 which indicates that the greatest frequency was 'often' with 18 students (54.5%); then 'always' with nine students (27.3%).

Usage	Frequency	Percent
Always	9	27.3%
Often	18	54.5%
Sometimes	6	18.2%
Never	0	0.0%
TOTAL	33	100%

Table 4-8 : Students' internet usage for learning

Q2 - What do you mostly focus on when using the internet?

This question was asked in order to discover what area students focus on most when using the internet, therefore the students were given a number of answers such as fun and games, reading news, learning and everything. Nineteen students (57.6%) said they focus on everything while 11 students (33.3 %) said they focus on social networks when using the internet. Table 4.9 shows the students' frequency regarding their area of focus.

Area	Frequency	Percent
Social Networks	11	33.3%
Fun & games	1	3.0%
Reading news	1	3.0%
Learning	1	3.0%
Everything	19	57.6%
Other	0	0.0%
TOTAL	33	100%

Table 4-9 : Frequency of students' area of focus

Section three of questionnaire form PQ1 consists of nine questions aimed at discovering students' opinions about the way in which lectures are delivered in their colleges. It will also show what attributes could be developed to enhance the lecturing process.

Q3- What type of lecture is delivered in your college?

Students were asked to choose between five answers: traditional lectures, live lectures, presentation slides, interactive lectures and other. A total of 22 students (66.7%) answered "traditional lecture", while the rest (33.3%) said "e-lecture (presentation slides)". No students answered "live" or "interactive lectures". Table 4.10 shows the frequency and percentage of this issue.

Type of lecture	Frequency	Percent
Traditional lecture	22	66.7%
Live lectures	0	0.0%
E-lecture (presentation slides)	11	33.3%
Interactive lectures	0	0.0%
Other	0	0.0%
TOTAL	33	100%

Table 4-10 : Frequency of type of lecture delivered in students' colleges

Q4- Does your college deliver lectures for all students on its website?

Students were asked to answer yes or no to this question. The greatest frequency of students (93.9%) said their college did not deliver lectures on its website, while two students (6.1%) said theirs did. Table 4.11 shows the frequency with which lectures were delivered on college websites.

College delivers lectures on its website	Frequency	Percent
Yes	2	6.1%
No	31	93.9%
TOTAL	33	100%

Table 4-11 : Frequency of colleges who deliver lectures on their websites

Q5- What type of lecture is delivered on your college website?

Students who answered yes in question 4 were asked to choose between five answers: Traditional lecture, live lecture, presentation slides, interactive lecture and other. Both

students (100%) answered ‘e-lecture (presentation slides)’. Table 4.12 shows the frequency and percentage of this issue.

Type of lecture	Frequency	Percent
Traditional lecture	0	0.0%
Live lecture	0	0.0%
E-lecture (presentation slides)	2	100%
Interactive lectures	0	0.0%
Other	0	0.0%
TOTAL	2	100%

Table 4-12 : Frequency of type of lecture delivered in college website

Q6- Do you think there is a need to see your lectures via your college website?

Students were asked to answer yes or no to this question. The majority of students (93.9%) said they would like to see their lecture via the college website while two students (6.1%) said they would not. Table 4.13 shows the frequency of students’ answers.

Like to see lectures via college website	Frequency	Percent
Yes	31	93.9%
No	2	6.1%
TOTAL	33	100%

Table 4-13 : Frequency of students interested in seeing lectures online

Q7- Do you prefer traditional lectures or online lectures?

In this question students were asked whether they preferred the traditional lecture or the online lecture. The results reveal that nine students (27.3%) preferred the traditional lecture, while the greater number of respondents (72.7%) preferred the online lecture. Table 4.14 shows students’ frequency regarding this issue.

Preference of lecture	Frequency	Percent
Traditional lecture	9	27.3%
Online lecture	24	72.7%
TOTAL	33	100%

Table 4-14 : Frequency of students’ preference of lecture type

Q8- In the case of electronic lectures do you prefer to watch an entire online lecture all at once, or in short interactive clips?

In the case of electronic lectures delivered online, students were asked whether they preferred to see a lecture all at once, or in short interactive clips, or both. The majority of them (39.4%) said short interactive clips, while 11 students (33.3%) preferred both. Further details can be seen in Table 4.15.

Type of interactive lecture	Frequency	Percent
Whole lecture at once	9	27.3%
Short interactive clips	13	39.4%
Both	11	33.3%
TOTAL	33	100%

Table 4-15 : Frequency of type of interactive lecture preferred

Q9-In your opinion, is it more useful to just watch the lecture or to watch and interact with it?

Table 4.16 shows that 100% of students agreed that they prefer to watch and interact with lecture content. Therefore nobody indicated they want to just view the lecture without interaction.

Watching lecture	Frequency	Percent
Just watch	0	0.0%
Watch and interact	33	100%
TOTAL	33	100%

Table 4-16 : Frequency regarding preference to interact with lecture

Q10- Are you interested in learning via interactive web applications?

Students were asked if they were interested in learning via an internet application. Slightly more than half of them were interested, while a third were very interested, and only five (15.2%) said they did not care. Table 4.17 shows the level of students' interest in internet applications.

Interest in interactive web application	Frequency	Percent
Very interested	11	33.3%
Interested	17	51.5%
Do not care	5	15.2%
TOTAL	33	100%

Table 4-17 : Frequency of students' interest in learning via internet app

Q11- How often do you communicate online with your lecturer?

Students were asked how often they communicate with their lecturer. The majority of them indicated that they do not communicate with their lecture online as shown in Table 4.18.

Usage	Frequency	Percent
Always	0	0.0%
Often	0	0.0%
Sometimes	3	9.1%
Never	30	90.9%
TOTAL	33	100%

Table 4-18 : Frequency of students' online communication

4.5.2 Results Extracted from Form PQ2

Fourteen lecturers completed questionnaire Form PQ2 (Appendix B), 12 male and two female. Form PQ2 consisted of three parts. The first part determined lecturers' demographics, which can be seen in more detail in Tables 4.5, 4.6, and 4.7. The second part was designed to check who was qualified to participate in this research. The third part consisted of 12 questions in total, designed to discover lecturers' attitudes as to whether there is a need for IELTS, and to discover some issues with regard to the research.

Q1- How often do you use the internet to communicate with your students?

This question was designed to discover how often lecturers communicate with their students using the internet. The set of answers was: always, often, occasionally, and never. Three lecturers (21.4%) indicated they occasionally communicate with their students while 7.1% said they do so often. Ten lecturers replied that they never communicate with students via the internet. Table 4.19 shows the frequency of level of communication between lecturers and their students.

Frequency with which lecturers communicate with students	Frequency	Percent
Always	0	0.0%
Often	1	7.1%
Occasionally	3	21.4%
Never	10	71.4%
TOTAL	14	100%

Table 4-19 : Frequency of lecturers' communication with students

Q2- What do you mostly focus on when using your college website?

Question 2 was designed to discover what the lecturers focus on when using their college website. The possible answers were: setting up a timetable of lectures; communicating with students; uploading lecture slides; providing students with useful links; and everything. The answers reveal that two categories showed the same frequency, with three lecturers (21.4%), while the majority of lecturers (35.7%) said they focus on setting up the timetable of lectures. This is shown in more detail in Table 4.20.

Lecturers' focus when using college website	Frequency	Percent
Setting up the timetable of lectures	5	35.7%
Communicating with students	3	21.4%
Uploading lecture slides	2	14.3%
Giving students useful links	1	7.1%
Everything	3	21.4%
TOTAL	14	100%

Table 4-20 : Frequency of focus when using college website

Q3- Which methods do you use to deliver your lectures?

This question was designed to show what type of lectures the lecturers deliver to their students. As shown in Table 4.21 four answers were provided for lecturers and 64.3% of them said they use traditional lectures, while 35.7% of lecturers said they use presentation slides.

Type of lectures delivered	Frequency	Percent
Traditional lectures	9	64.3%
E-lectures (presentation slides)	5	35.7%
Interactive lectures	0	0.0%
Other	0	0.0%
TOTAL	14	100%

Table 4-21 : Frequency of type of lectures delivered

Q4- Does your college offer lectures to all students on its website?

The aim of this question was to find out what percentage of colleges deliver lectures on their websites. A total of 71.4 % of lecturers said theirs did not while four lecturers (28.6%) said theirs did, as shown in Table 4.22.

Are lectures delivered on college website	Frequency	Percent
Yes	4	28.6%
No	10	71.4%
TOTAL	14	100%

Table 4-22 : Frequency of colleges delivering lectures on their websites

Q5- If you answered yes to Question 4, what kind of lectures are offered?

Only four out of fourteen lecturers answered this question because it depended on Question 4. One hundred percent of them said presentation slides were viewed on their college website and nothing else. Table 4.23 provides more details.

Type of lectures offered by colleges for students on their websites	Frequency	Percent
E-lecture (presentation slides)	4	100%
Recorded lectures	0	0.0%
Live lectures	0	0.0%
Interactive lectures	0	0.0%
Other	0	0.0%
TOTAL	4	100%

Table 4-23 : Frequency of type of lecture viewed on website

Q6- If you answered yes to Question 4, what kind of students are allowed access to these lectures?

This question was only to be answered by those who answered yes to Question 4; therefore only four lecturers answered this question. All 100% of them said all students were allowed to view lectures from the college website. Table 4.24 shows the result.

Students allowed to view lectures online	Frequency	Percent
All students	4	100%
Absent students	0	0.0%
Full time students	0	0.0%
Part time students	0	0.0%
TOTAL	4	100%

Table 4-24 : Frequency of students allowed to view lectures online

Q7- How interested are you in teaching your students by interactive web application?

This question was asked to discover who was interested in delivering lectures in an interactive application environment. Table 4.25 shows that the majority of lecturers (64.3%) replied that they were interested while 35.7% said they were very interested, and none said they do not care.

Interest in delivering interactive lectures	Frequency	Percent
Very interested	5	35.7%
Interested	9	64.3%
Do not care	0	0.0%
TOTAL	14	100%

Table 4-25 : Frequency of how interested lecturers are in delivering interactive lectures

Q8- Do you think the e-lecture is still the most suitable way to deliver lectures to students?

Lecturers were asked their opinions regarding the most suitable way of lecturing and whether or not the traditional way is more suitable. A total of 57.1% of them said that it is still the most appropriate method of lecturing, while 42.9% said it is not, with a frequency of six, as shown in Table 4.26.

E-lecture still the suitable way of lecturing	Frequency	Percent
Yes	8	57.1%
No	6	42.9%
TOTAL	14	100%

Table 4-26 : Frequency of suitable way of lecturing

Q9- Do you think there is a need to create interactive electronic lectures?

The aim of this question was to discover whether there is a need to create an interactive application as a format for lecturing; all lecturers agreed that there is. Table 4.27 shows the details.

Need to create interactive electronic lectures	Frequency	Percent
Yes	14	100%
No	0	0.0%
TOTAL	14	100%

Table 4-27 : Frequency of need to create interactive electronic lectures

Q10- Do you think interactive electronic lectures will have a positive effect on student achievements?

Table 4.28 shows that 100% of lecturers think there will be a difference in student performance when using interactive electronic lectures.

Interactive electronic lectures affect student performance	Frequency	Percent
Yes	14	100%
No	0	0.0%
TOTAL	14	100%

Table 4-28 : Frequency of whether IEL will affect students' performance

Q11- In the case of electronic lectures do you suggest interactive electronic lectures should be delivered all at once, or as short interactive clips, or both?

In the case of interactive electronic lectures being delivered, lecturers were asked whether they preferred to deliver them as a whole lecture at once, or in short clips, or both. A total of 50% with a frequency of seven indicated that they preferred short interactive clips, while 42.9% replied that they preferred to deliver both, and just one lecturer said they preferred to deliver the whole lecture at once. Table 4.29 shows the results.

Type of interactive electronic lecture	Frequency	Percent
Whole lecture	1	7.1%
Short interactive clips	7	50.0%
Both	6	42.9%
TOTAL	14	100%

Table 4-29 : Frequency of type of interactive electronic lecture preferred

Q12- Who do you think would benefit from interactive electronic lectures?

Lecturers were asked their opinions on who would benefit from interactive electronic lectures: all of them agreed that all students would benefit. Table 4.30 shows the results.

Students who would benefit from IEL	Frequency	Percent
All students	14	100%
Absent students	0	0.0%
Full time students	0	0.0%
Part time students	0	0.0%
TOTAL	4	100%

Table 4-30 : Frequency of students who would benefit from IEL

4.5.3 Results Extracted from Open Questions

Regarding the lecturers' answers to Question 11, they were required to clarify their answer and explain why they chose a particular type of interactive lecturing system. As shown in Table 4.29, one lecturer replied that they preferred to deliver the whole lecture at once, while six preferred to use both types, and seven lecturers preferred to deliver the lecture in short clips. Table 4.31 shows the lecturers' reasons for choosing a particular method of delivering the interactive lecturing system.

No.	Subject Department	Type of Delivering IEL	Reason for chosen answer
1	IT	Short clips	Viewing the interactive lecturing system in small sections increases the students' understanding; it also makes the lecture topic more interesting and avoids monotony.
2	Education	Short clips	Showing the interactive lecturing system in short clips is better; it will fit it in with the lecture plan and giving it in sequence could be more useful for students' achievements.
3	IT	Short clips	It is better to deliver the interactive electronic lecture in short clips because this will enable students to easily understand the lecture contents.
4	Mathematics	Short clips	I prefer to deliver the interactive lecturing system in short clips. When a lecture is broken up into sections it allows scope for more explanation and prevents students from depending on just one primary source or material for the lecture, which occurs when it is delivered as a whole.
5	Physics	Short clips	In my opinion a sequence of clips achieves more understanding in the learning process
6	English	Short clips	This is a busy time of globalisation, so it is difficult to find time to watch long lectures Therefore viewing lectures in short clips is more suitable. This type of lecture is also more appropriate for part time students who have to work and study at the same time.
7	Education	Short clips	Short clips are more useful; they make students more attentive and leave them wanting to find out the rest of the information. Also, they become motivated to find out more and complete all the clips.
8	Business	Both	I think it depends on the nature of the lesson and student preference. Some students want to view all at once, and others want to view in short clips
9	Education	Both	The whole lecture is useful for those who want more clarification to consolidate the information, especially in the scientific disciplines. But short clips are appropriate for delivering quick information.

No.	Subject Department	Type of Delivering IEL	Reason for chosen answer
10	Mathematics	Both	It depends on the lecture; some lectures require more details to be given to complete an idea while others just require a quick view.
11	Physics	Both	It depends on many things such as lecture content, duration, combination of lecture parts and curriculum
12	Business	Both	It depends on the module and the lecture contents. For full time students I think it is better to view the whole lecture because it is their duty.
13	Education	Both	It depends on the type and duration of the lecture, as well as on the level of difficulty of the curriculum and the students' perceptions.
14	Business	Whole lecture	I think is better for my lectures and subject

Table 4-31 : Reasons for delivering whole lecture or clips

At the end of the questionnaires (Form PQ1 and Form PQ2) participants were asked to give their comments regarding their opinion on developing a new system to increase learning outcomes, communication and interactivity between students and their lectures. Their responses are shown in Table 4.32

No.	Participant status	Comment
1	Student	I think that the creation of a new interactive application for lecturing would have a positive impact and would be in line with the technical evolution in the field of e-learning if it is easy to learn, easy to use and easy to access.
2	Student	The creation of an interactive application for lecturing is a shift from the traditional lecture style and it provides an atmosphere of freedom and more interaction with lecture content.
3	Student	I think that adding an interactive application for lectures would play a major role in creating a competitive environment among students and provide a degree of freedom in the non-adherence to time or place.
4	Student	I prefer online lectures because they make me feel more dynamic and allow for a wide range of flexibility of learning when it is easily useable and accessible.
5	Student	Yes, I welcome the idea of applying a new lecturing system, whenever it helps to save time and effort when it is easy to register and navigate inside.
6	Student	In my opinion, interactive and learnable applications help to absorb information and make it easy to remember it later.

No.	Participant status	Comment
7	Student	I like to see the lecture as interactive content because it helps me to review it again and again, especially when the system is easily accessible and useable.
8	Student	Interactive application for lectures is a good idea for e-learning but it needs lots of effort and materials.
9	Student	The development of the application for interactive lectures will help in learning anytime, anywhere.
10	Student	Interactive applications, in my opinion, help to summarise the main points of the lecture and focus on them.
11	Student	I think an interactive application is good for lecturing and facilitates communication between students and their lecturers.
12	Student	In my opinion it is good to create an application which offers interactive learning at any time and enhances communication between students and their lecturers.
13	Student	Developing an interactive application for lecturing helps students to access and use their lectures easily.
14	Student	It saves time and supports the learning process in particular with easy access.
15	Lecturer	I think any project such as the interactive lecturing system can enhance the learning process if we can overcome all obstacles such as user training and availability of facilities.
16	Lecturer	Finding a new system to develop interactivity in lecturing is a good idea when it is developed to be an accessible application and is available for all students and disciplines.
17	Lecturer	A very good topic but I suggest spreading the culture of the interactive lecturing system then it could be applied, and I suggest it should be an accessible and useable system
18	Lecturer	Finding a new system, such as the interactive lecturing system, is a good project when we overcome all problems or obstacles that we face such as communication and interactive learning. Also, we need to encourage people to work on the new system
19	Lecturer	Whenever and wherever the student wants, easy to use and learn as they want. I support such an application and I recommend the easy access and enhanced classes for all users
20	Lecturer	I believe that such an interactive lecturing application will enhance the learning process at KAU if all users receive good training
21	Lecturer	Electronic lectures are a quick way to deliver online learning. I welcome such an idea
22	Lecturer	According to the e-learning revolution we are in need of an interactive and useable application that could easily support my work in lecturing
23	Lecturer	Interactive applications are a good proposal to support lecturing but we still in need the traditional lecture

Table 4-32 : Participants comments

4.6 Discussion

The results will be discussed based on the analysis in the preliminary study. Form PQ1 and Form PQ2 were analysed to determine the participants' opinions with regards to the current situation and the desired situation when delivering lectures. This study showed that 66.7 % of students and 64.3% of lecturers indicated that lectures were still delivered in the traditional method, as shown in Tables 4.10 and 4.21. This leads us to say that the lecturing process is still in its infancy at KAU, and needs some development using technology such as new lecturing formats.

Also, this study found a preference for the online lecture by 72.7% of students, as shown in Table 4.14. While 64.3% of lecturers are interested and 35.7% are very interested as shown in Table 4.25. This indicates a serious demand for the creation of a new technology to deliver lectures online to students via the KAU website.

This study also showed that 100% of lecturers are very keen to be supported by an interactive application such as the IELS as shown in Table 4.25, and 84.8% of students are between interested and very interested in working on an interactive application as shown in Table 4.17. This emphasises a need to develop a new lecturing format which would create an interactive environment at KAU.

The participants gave their views regarding this application and emphasised that it could enhance the lecturing process at KAU.

With regards to the level of interactivity, the use of an interactive application for lecturing would enhance interactivity between students and the contents of lectures. As shown in Table 4.19, 71.4% of lecturers indicated that they do not communicate online with their students, while Table 4.18 shows that 90.9% of students said they never communicate online with their lecturer. This indicates that there is a need to find a suitable means of communication between them.

From the lecturers' perspectives, the study revealed that 100% of them think that the interactive lecturing system would have a positive effect on students' performance as shown in Table 4.28. In addition, the same proportion indicated that all kinds of student would benefit from interactive electronic lectures as shown in Table 4.30.

According to the open question asked at the end of questionnaire Forms PQ1 and PQ2, 14 students out of 33 and nine lecturers out of 14 submitted their opinions regarding the development of an interactive application for lectures; as shown in Table 4.31 and Table 4.32. Most of them welcomed such an application and emphasised that it would enhance the learning process at KAU, and would shift the lecturing process to a new format that could present lecture content with new technology. These responses showed that the development of an interactive application would improve communication between students and their lecturers and with each other. Their responses also showed that such an interactive application would strengthen the relationship between students and the content of the lectures and make students focus on the material in the application.

In addition, responses revealed that an online interactive application would create a free atmosphere for all users and allow them to learn wherever and whenever they wanted. Finally, the preliminary study found there is a need to create an online interactive application to enhance the lecturing system at KAU.

4.7 Conclusion

This study was conducted in order to discover the situation regarding the delivery of lectures at KAU. It also aimed to discover a number of issues related to the learning process and preference of method of delivering lectures between students and lecturers. Thirty-three students and fourteen lecturers were randomly participated in this study, and two forms of questionnaire were distributed online to obtain their opinions regarding this issue. The study found that it would be feasible to develop and establish a new interactive electronic lecture system in order to support the lecturing process at KAU. It also found that such an interactive application may improve the learning outcomes and achieve greater communication between students and between students and lecturers. It may also bring a high level of interaction between students and the content of the lectures.

The next chapter will illustrate the IELS and what theories it is based on. Then it will describe what features and functions will be included. It will also identify who its users might be.

5 Interactive Electronic Lecture System

5.1 Introduction

The primary purpose of this research is to enhance and support the learning and communication processes at King Abdulaziz University (KAU) in Saudi Arabia. An interactive electronic lecture system (IELS) was developed and designed to achieve this purpose. In this chapter, the notion behind the creation of this system is highlighted, and applied learning theories are discussed, and users of the IELS are identified and its benefits are described. This chapter also outlines the way in which the screen designs for the IELS were made. Six main issues were taken into consideration when developing this system: learnability, accessibility, usability, interactivity, communication, and user satisfaction. The way in which these issues were gathered and presented into a novel format via the IELS are described. Moreover the functionality of the system and its features and specification are also illustrated and some system screens are discussed.

Taking users' requirements into consideration is a fundamental aspect of developing or designing a system, and these were obtained from the preliminary study. In general, young people prefer to use gadgets, and spend a great deal of time on them. They can be seen using them on trains and buses, and they even do their work at home using apps. Before starting this research an oral pilot study was carried out regarding the delivery of lectures at KAU. Some undergraduate students at the university were asked if they would prefer lectures to be delivered via smooth web applications and most of them welcomed the idea. This opinion was confirmed by the preliminary study as described in more detail in Chapter 4.

5.2 IELS Learning Theories

The IELS is based on established learning theory and its implementation is based on sound software engineering methods. Connectivism theory (a digital age theory) offers specific technological opportunities for the learner to be actively involved in the presentation of a body of knowledge (Duke, Harper and Johnston, 2013). Therefore students are able to

recognise and interpret patterns by connecting to diverse representative networks. On the other hand, constructivism theory says that learning is a social activity associated with the individual coming into contact with others: teachers, peers, family and friends. Learning does not occur instantly, but it takes time, and real learning needs individual ideas to be re-checked again and again, which leads to reflection and testing that in turn leads to learning (Payne, 2009).

According to the theories that were applied to develop the IELS, a comparison will be made between the e-lecture and the IELS to check and examine the students learning outcomes and their exchange of information. It also will help to explore how students engaged and involved with the lecture content and find out how effectiveness using the IELS was reached.

5.3 IELS Users

There are three types of user who will work with IELS: administrators, lecturers and students. Each user has to be registered to be a user of IELS, and each type of user has certain privileges and permissions.

5.3.1 IELS Administrator

The administrator is the person responsible for the maintenance and for setting up all basic permissions such as activating and managing users' accounts, setting the taught modules' names and attributing them to the lecturers, and enabling or disabling users' accounts.

5.3.2 IELS Lecturer

Lecturers are the ones who put the content into the IELS. 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 video 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 or 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 box 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.

5.3.3 IELTS Student

Students are the main users of IELTS; 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 using and evaluating this system. As the users of the system they can register, sign in, and edit their personal settings and sign out of the system.

When students are allocated to a lecture course, they can see all their enrolment records which show all lectures and video 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 video clips inside. When students click on the name of the video clip it will automatically be ready for interaction. Thus, every action taken during the viewing of video clips will be recorded in the student's record and it will show 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 video clips they will be allowed to enter a chat box with their lecturer and their fellow students 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.

5.4 IELTS Application Specification

IELS consists of four main components including lectures, video clips, and interactive interfaces as shown in Figure 5.1. The main reason for developing IELTS was to enhance the learning and communication process at KAU. IELTS delivers lectures to undergraduate students in a new format that creates an interactive environment which enables students to interact with the lecture content as well to communicate with other system users such as their lecturers and colleagues.



Figure 5-1 : Main components of IELS

This system will enable a flexible lecturing format that is suitable for any module, can be uploaded as short video clips, and then certain actions can be carried out which enable users to interact with the lecture content. Based on the preliminary study conducted in this research, as described in Chapter 4, and taking into consideration the users' requirements stated in Chapter 2, for the IELS to be a reliable and effective lecturing system it must include certain attributes such as accessibility, usability, learnability, interactivity, communication and satisfaction. Figure 5-2 shows the IELS attributes.

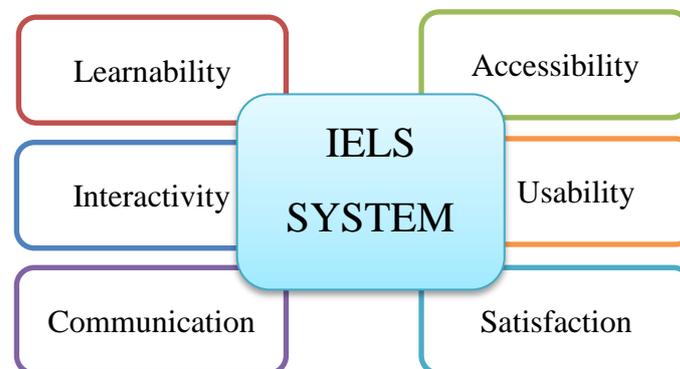


Figure 5-2 : IELS attributes

5.4.1 Accessibility

When developing the IELS it was important to ensure easy access to its content; therefore some features relating to accessibility were picked up from the users' comments that were presented in the preliminary study, specified in Chapter 4. As defined in Chapter 2, it is essential for the features of the system to meet the requirements of the users (Section 2.4). The IELS must offer easy access to its content so that users can register, sign in, and sign out without difficulty. Also the IELS must run over the internet because it gives easy access to

the system and provides easy access to its content. Figure 5.3 illustrates the accessibility of the IELS.

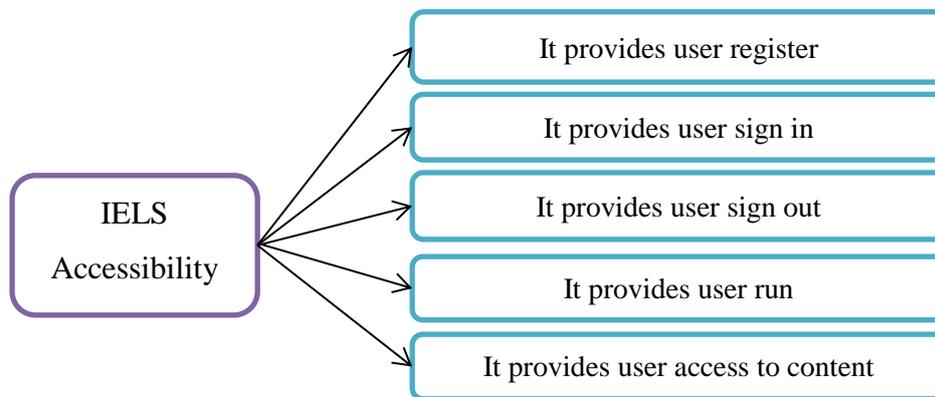


Figure 5-3 : IELS accessibility

5.4.2 Usability

According to the users' requirements and the goals of the IELS and its specifications, many features needed to be considered when designing the IELS. Some of those features related to the system interface and some of them related to its content. However, all of them helped to create a usable system. A user of the IELS must be able to edit personal settings, view module lists, view lecture lists, view video clips, view credits and perform easy navigation. Figure 5.4 shows the main functions representing the usability of IELS.

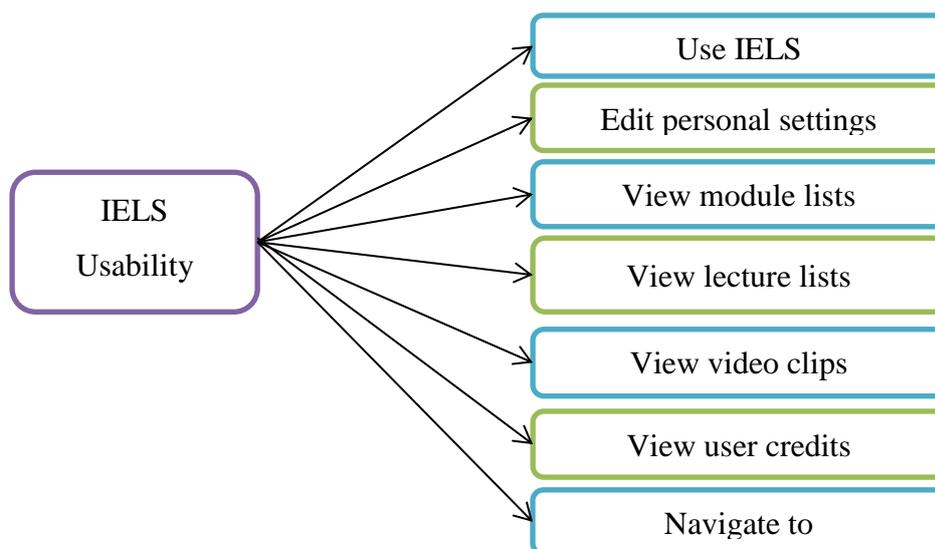


Figure 5-4 : IELS usability

5.4.3 Learnability

Based on connectivism and constructivism theories, the interactive electronic lecture system (IELS) has been developed as a combination of interactive interfaces and actions to allow students to be actively involved in the body of knowledge being taught. It will also give them the space and freedom of a learning environment which will help them to build and own their knowledge and to have a positive experience. The combination of interactive interfaces and web technologies allows instructors to develop an interactive application for the student in an online environment (Chittaro and Ranon, 2007). The IELS has been built to facilitate the learning process, add interactive actions, and offer learning at any time. It has been developed to simplify learning by presenting knowledge in an easier and quicker way than the e-lecture. Figure 5-5 shows the elements of learnability of the IELS.

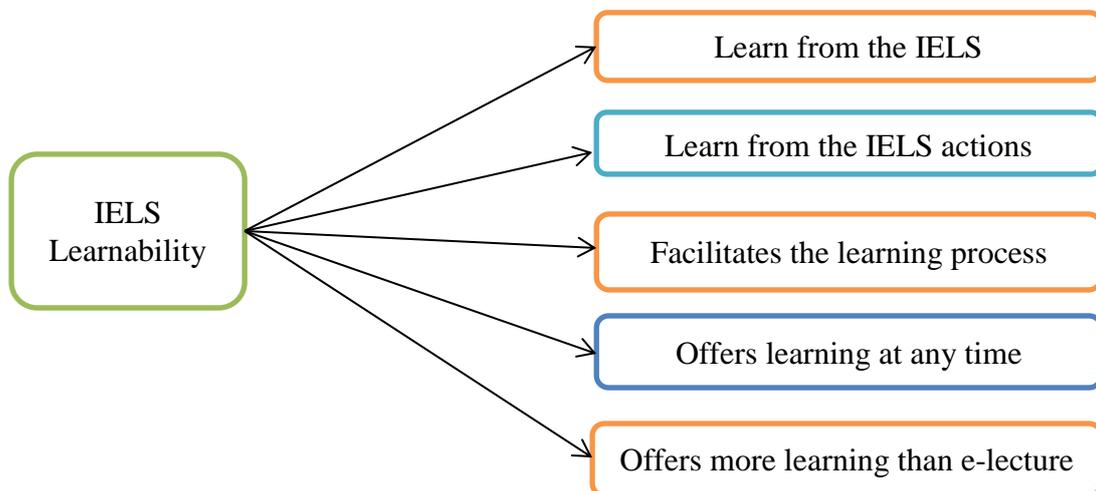


Figure 5-5 : IELS learnability

5.4.4 Communication

Communication is the means of exchanging information or ideas between two sides or more via some channel, including signs or symbols. The communication process is the answer to the following questions: Who says? What is said? Through which channel? To whom? With what effect? (Lasswell, 1948). Communication permeates all levels of human expertise and it is central to understanding human behaviour and to changing behaviour among individuals, organisations and societies (Servaes, 2008). Communication is the process of exchanging

knowledge and meaning by use of signs and symbols (Morreale, Spitzberg and Barge, 2007). It consists of encoding and sending messages and receiving and decoding them. In this context there are five main elements which make up the communication process: sender, receiver, message, channel and feedback. These are shown in Figure 5.6. The IELS is an advanced system that was created to be an effective channel to enhance the communication process between students and lecturers at KAU. The promise of the IELS is that it must meet the needs of its users and that technology has a role to play in enabling access and effective communication. It also offers a rich environment for communication between its users and gives them more space and freedom. The new channels of communication also allow individuals to deliver messages easily to public receivers.

In addition, the IELS will enhance the communication process between students, and between students and their lecturer. The IELS grants students greater freedom than is offered in the e-lecture with regards to time and place. Students can ask questions, give and receive feedback, share their opinions, discuss, and offer suggestions freely without any stress or pressure.

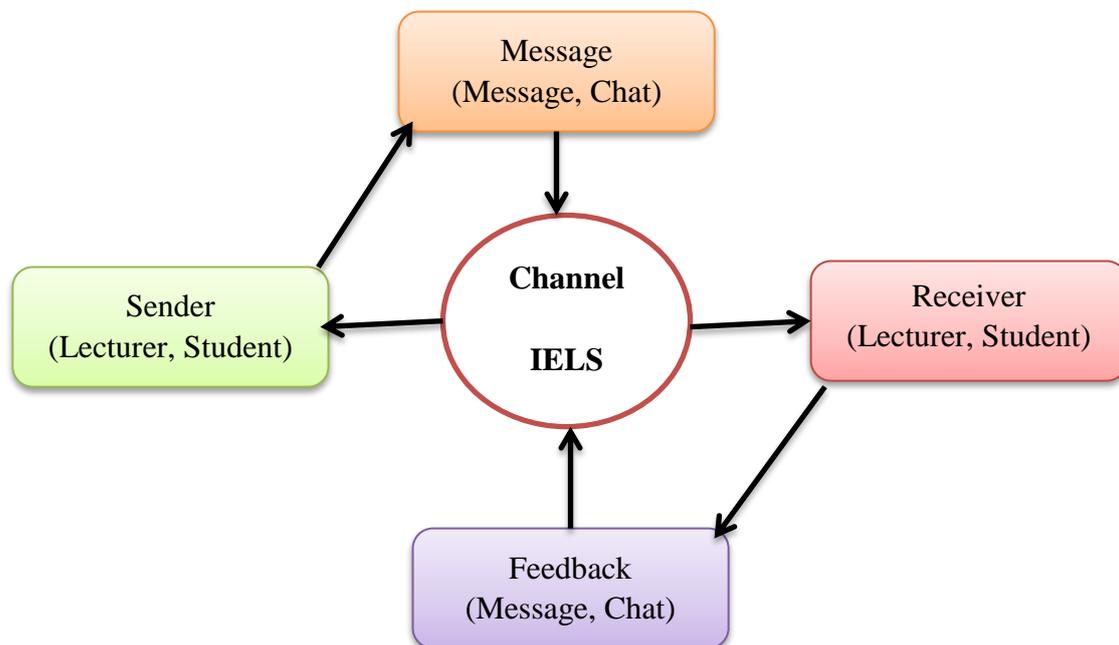


Figure 5-6 : IELS communication elements

5.4.5 Interactivity

For an interactive application learning environment to be successful, it is important that it should effectively facilitate learner interactions with the lecturing environment. Also, an effective user interface is a very important factor to consider, because it determines how easily students can focus on learning content without having to make any effort to figure out how to access it (Lohr, 2000).

IELS is an interactive system with the main focus on students' interactivity and engaging them with the lecture content. The use of the system will help to explain what level of interactivity can be achieved and this will be reflected in students' learning outcomes when the system is compared with an e-lecture.

The nature of IELS is to divide a recorded lecture video into many clips according to the duration of the lecture and the lecture topic. This system may enhance the learning process allowing students to learn when and where they want.

Another aspect of IELS is that it motivates students to focus on the lecture content when they view the lecture, in particular when they know that the system will test their understanding when they view the clips. So the actions (Popup or Click) will encourage them to concentrate and remain motivated. This means that students will focus and try to achieve a high level of credit which indicates their correct understanding of the lecture content. The system will also place students in a competitive learning environment which is another means of motivation.

5.4.5.1 Popup action

Popup action is an interactive question that appears randomly when the video clip is running. It is designed to make sure the students are following the content of the lecture and concentrating carefully. The lecturer has the privilege of setting up this action according to subtopics that need to be focussed on in the lecture. When the lecturer uploads the video clip they can allocate the action according to the time scale of the clip, which means the lecturer can allocate one Popup action or many according to the length of the video clip and its contents. This is done by setting up the actions depending on the duration of the clip, between the start second and the end second. For instance, if the lecturer wishes to ask the student many questions during a five minute video clip, the first one may appear from 0.10 to 0.30 seconds. This means that the student is given 20 seconds to answer the question, after which it will disappear. The second question may appear from 2.15 to 2.50 seconds, giving the

student 35 seconds to respond. The student is required to answer yes or no by clicking on the Popup question; the IELS will register the student's answer and save it in their record (for more details about the Popup action setup see Appendix D).

5.4.5.2 Click action

The technique of the Click action differs from that of the Popup action which appears then disappears. For the Click action, the lecturer uploads the video clip and identifies its duration and subtopic. Then the lecturer sets up a button saying (Click Here) which will appear at the bottom of the screen when the video clip begins. Statements regarding content from the video clip which need to be learned will appear at the bottom of the screen under the (Click Here) button. The student is required to read these statements, then watch the video clip and click on the button when the lecturer mentions each statement. The lecturer will allocate the questions in advance based on the topic. Another important factor of this action is that there is a maximum number of times the (Click Here) button can be used. This will encourage the student not to use it indiscriminately but rather to focus on the statements and video clip content and use it carefully (for more details about the Click action setup see Appendix D). This technique will also distribute the statements according to the time scale of the clip. So, all the statements will appear at the bottom of the screen during the video clip, but the first statement should be clicked from 0.15 to 0.28 and the second one should be clicked from 0.35 to 1.05 and so on. Figure 5.7 shows the IELS actions.

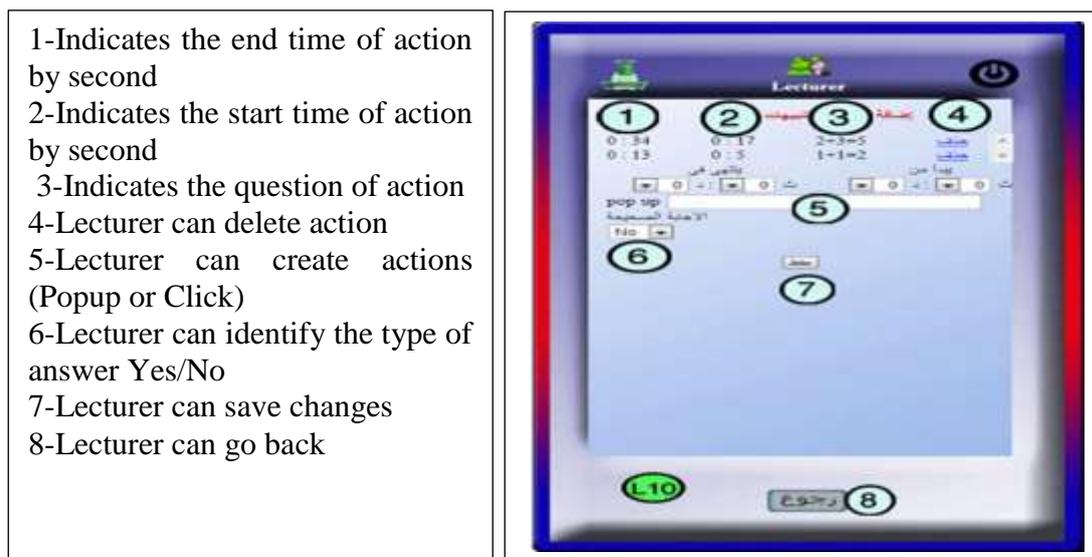


Figure 5-7 : The IELS Actions

5.4.6 User Satisfaction

User satisfaction is a key element in developing the IELS. A preliminary study was conducted to determine the specific user requirements regarding creating a new lecturing system. When developing the IELS some satisfaction elements from the review in Chapter 2 (Section 2.8) were taken into consideration such as interface colours, interface design, interface format, division of lecture into video clips, duration of video clips, system operation and speed. Figure 5.8 shows the IELS satisfaction elements.

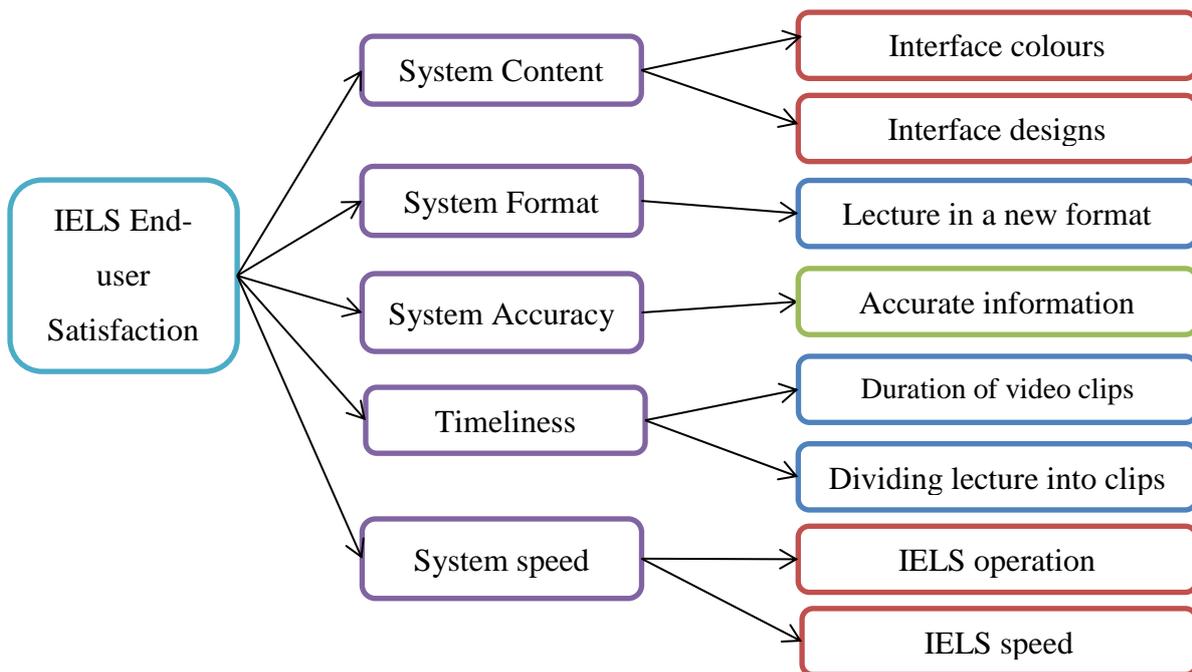


Figure 5-8 : IELS Satisfaction

5.5 User Interfaces and Functionality

The IELS has a number of interfaces that are dependent on the user and the functions. The main screen will have the following functions:

- 1- Enable user to login
- 2- Deal with forgotten password
- 3- Register with the system

5.5.1 Administrator Account

The IELS provides the administrator with the following functions. More details can be seen in Appendix D

- 1- Manage Modules
 - Create a new module
 - Assign a lecturer to a module
 - Amend a module information
 - Delete a module

- 2- Manage Personal Settings
 - Edit their first and last name
 - Edit their email address
 - Change and confirm their password
 - Save amended settings
 - Cancel amended settings

- 3- Manage User accounts
 - Activate a user account
 - Disable a user account
 - Search to find a particular user
 - Delete a user account

- 4- Manage Personal Message Box.
 - Write a message
 - Enter the subject for a new message
 - Send a message
 - Cancel a message

5.5.2 Lecturer Account

- 1- Manage Lecture
 - Create a new lecture name with description
 - Enter a lecture name
 - Assign the lecture to a module

- Assign the students to a lecture
- Delete a lecture
- Save changes
- Cancel changes

2- Manage Video Clip

- Create a new video clip name with description
- Upload a video clip file with clip icon
- Assign a video clip to a lecture
- Add the type of clip action (Popup or Click)
- Assign the students to the video clip
- Delete a video clip
- Set the start and end time of action
- Set the action statement or question
- Set the type of answer yes/no or other
- Edit a video clip
- Delete action
- Edit changes
- Save changes
- Cancel changes

3- Manage Personal settings

- Edit first and last name
- Edit email address
- Change and confirm password
- Save amended settings
- Cancel amended settings

4- Manage Personal Message Box

- Enter the subject for a new message
- Write a message
- Send a message
- Cancel a message

5- View Clips

- View video clips
- Check if actions work

6- Chat Room

- Post chat to students
- Receive chat from students
- Move between chat rooms according to the session

7- View Student Record

- View all students' records in some lectures
- View percentage of student interactivity with some lectures
- Search to view information about a particular student
- View correct and incorrect answers for some lectures
- View unmarked answers for some lectures

More details can be seen in (Appendix D)

5.5.3 Student Account

1- Manage Personal Settings

- Edit first and last name
- Edit their email address
- Change and confirm password
- Save amended settings
- Cancel amended settings

2- Manage Personal Message Box

- Enter the subject for a new message
- Write a message
- Send a message
- Cancel a message

3- View Module and Lectures

- View a list of modules

- View a list of lectures inside each module
- 4- View Clips
- View video clips inside each lecture
 - Interact with a lecture content
 - Answer the question by clicking or choosing yes/no
 - Review video clips
- 5- Chat room
- Post chats to lecturer or students
 - Receive chats from lecturer or students
- 6- View Student Record
- View their own record for some lectures
 - View percentage of their interactivity for some lectures
 - Search for a particular student
 - View correct and incorrect answers for some lectures
 - View unmarked answers for some lectures

More details can be seen in Appendix D.

5.6 Conclusion

In conclusion, this chapter has discussed the idea behind creating the IELS. It has also discussed the various aspects that may be supported by the system. IELS features and its functions have been discussed and how they were adopted in the IELS. Also IELS users were identified and the benefits they received were described.

The following chapter will explain how IELS was implemented and how its storyboards look. It will show what software and language programs were utilised to build the system. It will also set out how the database was created and what type of database was used. Furthermore, it will demonstrate how the system screens and image files were transferred between the PC and the internet server. Finally, it will provide a pilot user training session to check the running of the system.

6

IELS Implementation

6.1 Introduction

This chapter describes how the IELS was implemented. It shows what software and language programs were utilised to build the system and set out how the database was created and what type of database was used. Furthermore, it illustrates how the system screens and image files were transferred between the PC and the internet server. Finally, it demonstrates a pilot user training session to check the running of the system.

6.2 IELS Requirements

The IELS specification is considered to be a guide to this system; therefore a developer or designer is responsible for writing the project specification. It is useful to document the system by creating the steps which are to be followed. Writing a IELS specification follows the analysis phase, and is the most important phase of instructional design as it creates an easy, clear design for the new system. It also ensures the efficiency and the success of a development project (Szekely, 1995). The specification is written using an appropriate template which shows useful information about the new system explaining how users will interact with the proposed application, and includes some information about the users, situation, technologies, experiences, contents and learning outcomes. This information will help to define the application interfaces and its structure in order to develop it in the best possible way. Table 6.1 shows the IELS specification.

No	Function	Specification
1	Name of the System	Interactive Electronic Lecture System (IELS)
2	System Objects and Vision	<ul style="list-style-type: none"> -This system is designed to enhance the lecturing process at King Abdulaziz University (KSA) -It also aims to facilitate communication between undergraduate students and their lecturers. -It will enhance the level of development between student and lecture -It will shift lecturing from the e-lecture format to an interactive electronic format

No	Function	Specification
3	Users of the System	<ul style="list-style-type: none"> -Administrators (can activate and manage users' accounts) -Lecturers (can access, add lectures, obtain students' learning outcomes) -Undergraduate students (can access, learn, interact, communicate with other users)
4	Functional Requirements of the System	<ul style="list-style-type: none"> -The system should increase the level of user interactivity -The system should provide richness of multimedia components and features which evoke the user to interact -The system should present content in innovative screens -The system should move smoothly from one screen to another -The system should present a report for the lecturer on each student who is interacting with the IELS -Interaction with the system should help the student to engage with their learning environment -The system should enhance the learning process where and when the students want it
5	User interface priorities	User interfaces to some extent resemble smart phones. Navigation is designed using icons to facilitate access to IELS
6	Technologies to be used	<ul style="list-style-type: none"> -Short video clips -Popup action (interaction) -Click action (interaction) -Message box (communication) -Chat box (communication)
7	Tools to be Used	<ul style="list-style-type: none"> -PHP via Dreamweaver CS6 (main environment design) -JavaScript (add some coding) -Adobe Photoshop CS8.0 (screen and interface design) -Adobe Photoshop Image Ready CS8.0 (logo design) -MySQL 4.0.8 (database) -FileZilla 3.7.3 (transfer the system files between the developer machine and IELS server)

Table 6-1 : IELS specification

6.2.1 IELS Design (ADDIE Model)

Successful design approach that is based on users' requirements ensures successful learning outcomes and effective communication between users. ADDIE (Analyse, Design, Develop, Implement, Evaluate) is a continuous circle learning design model in which every phase is evaluated and developed when there is a need, Figure 6.1 shows the ADDIE circle (Krishnamurthi, 2012) as a learning design model to enhance instructional development and design. This model is a comprehensive model within learning design, because it allows designers and developers to concentrate on the learning design process from the beginning of the prototype phase, which is the analysis of the users' requirements, to the end of the

prototype phase, which is evaluation of the whole process. In this model an evaluation is carried out after each phase.

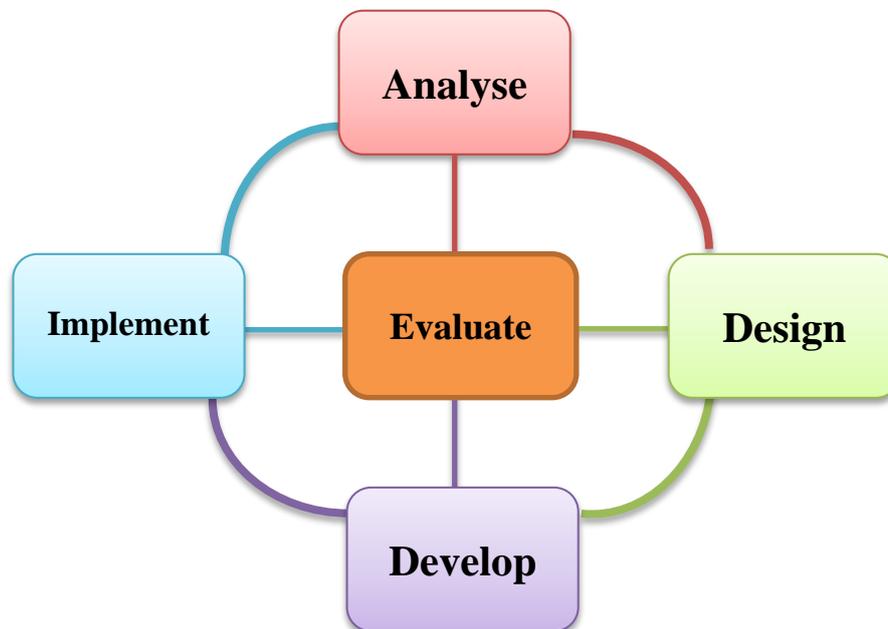


Figure 6-1 : ADDIE circle design

6.2.1.1 Analysis

Analysis is the foundation phase of the ADDIE process, and is very important in the development of learning design. It is necessary to undertake sufficient investigation into every aspect of the learning process. This should be carried out by a designer who should brainstorm to clarify, identify and analyse all possible scenarios that may be applied in the learning process (Royal and Education, 2007). The investigation should consider many factors, including the learner's requirements and needs, content, materials, facilities, curriculum, learning goals and outcomes. Moreover, the designer should carry out some research on all the relevant techniques which could provide critical information for the next process.

To analyse and determine the requirements and the feasibility of the creation of the IELS, a preliminary study was conducted, in which two types of user participated (33 students and 14 lecturers). Taking users' requirements into consideration is a fundamental aspect of developing or designing a system and these were obtained from the preliminary study

(Chapter 4). This phase was conducted to investigate and determine the answers to the questions raised:

- Who is the learner?
- What are the learner's needs?
- What will the learner learn?
- What outcomes may be achieved?
- What content exists?
- What content could be applied?
- What kind of lecture do learners prefer?
- Would it be feasible to develop an application such as the IELS?

The preliminary study was conducted on undergraduate students at KAU. Results showed that they liked to use their mobile devices, and spent a great deal of time on them. They enjoyed their gadgets, using the interactive application and working on them. All the users were keen to work on a system such as the IELS. The study also found there was feasibility in the development of an interactive electronic lecture system to support the learning process at KAU and that such an interactive system would improve the learning process and achieve greater communication between students and between students and their lecturers.

6.2.1.2 Design

According to Clarke (2001), the knowledge of storyboarding is vital for everybody in production who has to perceive and communicate visuals. Laying out project storyboards is a crucial part of the information systems design process, and is the initial step in creating any task; it is the basic design idea. One storyboard for each screen of this project's design was laid out on paper by hand, showing the connectivity of the screens. A storyboard is a series of drawings which illustrate what you want the main moments or 'shots' to look like, with a rough impression of background and character positions (Jew, 2013). Its importance is to anticipate what the potential user needs from the system and also to estimate their likely reaction to it. A storyboard view provides an easy way of seeing all the slides within a project at a glance and also facilitates an overview of the flow of the project (Haesen *et al.*, 2010). The designer can simultaneously change the properties of the storyboard to select an appropriate one. This technique is very important in designing the IELS because it allows the designer to imagine how the user interface will look in reality and provides a clear vision of

what is going to be developed. Thus, the storyboard provides a very useful function with which to begin. Figure 6.2 shows some initial project storyboards for introductory and normal screens. For example, in Figure 6.2 the storyboard for the IELS shows the first screen, which includes two text areas, one for username and the other for password, and three buttons which navigate to login, remember, and register. It also shows the system logo.

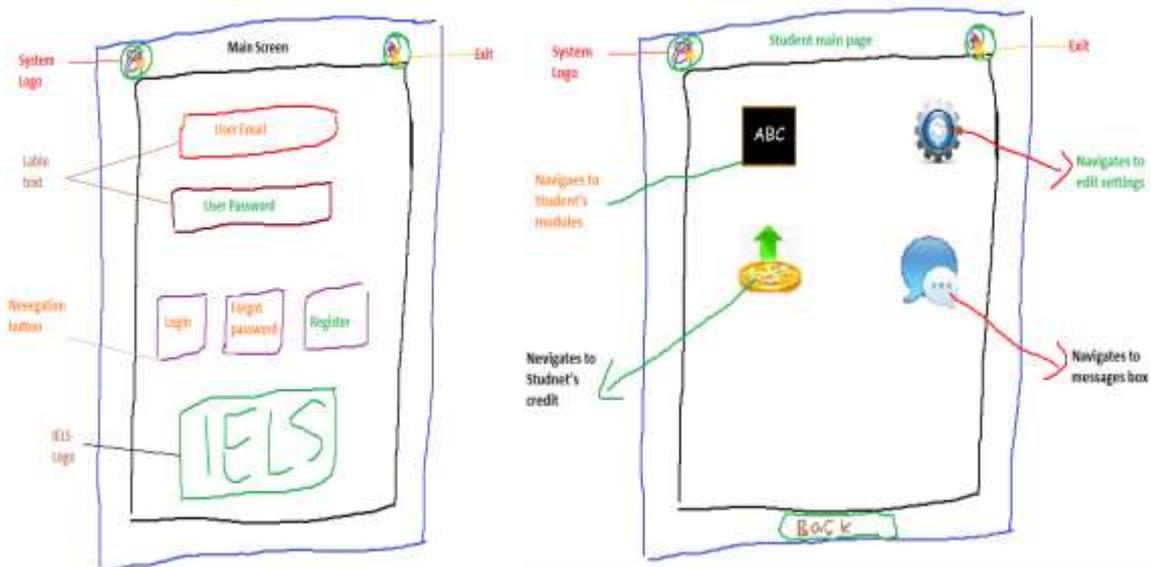


Figure 6-2 : IELS storyboards

The full storyboards which were implemented are shown in Appendix D and reflect the functionality of the IELS as defined in Chapter 5.

6.2.1.3 Implementation

Execution of work may be applied in this phase, possibly with the involvement and interaction of the learner, and includes the content of the system. The aim of the implementation phase is to check whether or not the IELS meets the learner's needs and requirements. It involves actual delivery of learning objectives to the learner throughout the learning process, and training must be an integral part in this phase (Ehlers and Pawlowski, 2006). During this phase the implementers also obtain IELS users' feedback to allow them to progress to completion of the project or, if necessary, to redesign the system. Some challenges or obstacles may be observed and so the programmer will be able to refine and redesign the prototype. It is important to realise that this phase is just a part of the design process and not the end of the process, because the quality and variety of the context of the design process requires all phases to be implemented.

6.2.1.3.1 *IELS implementation tools*

Understanding users' requirements is essential in the development of a new system and this was one of the priorities when creating this system. The preliminary study carried out in this research explains what level of users' requirements was needed. Many tools were used to build the IELS. Some, such as Photoshop, were used to generate the system's screens, while others, such as Dreamweaver, were used to incorporate the system's components to create an integrated system based on PHP.

6.2.1.3.1.1 *Adobe Photoshop CS*

Photoshop is a series of image software programs made by Adobe which is commonly used by graphics developers. The Adobe Photoshop CS 8.0 is the version that was used to design the IELS images and interfaces. Its purpose is to edit and create all system screens. Adobe Photoshop is an image-editing program which helped to perform a variety of functions in graphics and interfaces of the IELS. In addition it was used to design and construct the IELS interfaces. IELS screens and icons were designed and edited by Photoshop CS 8.0; Figure 6.3 shows a screen shot of the main screen design of the IELS.

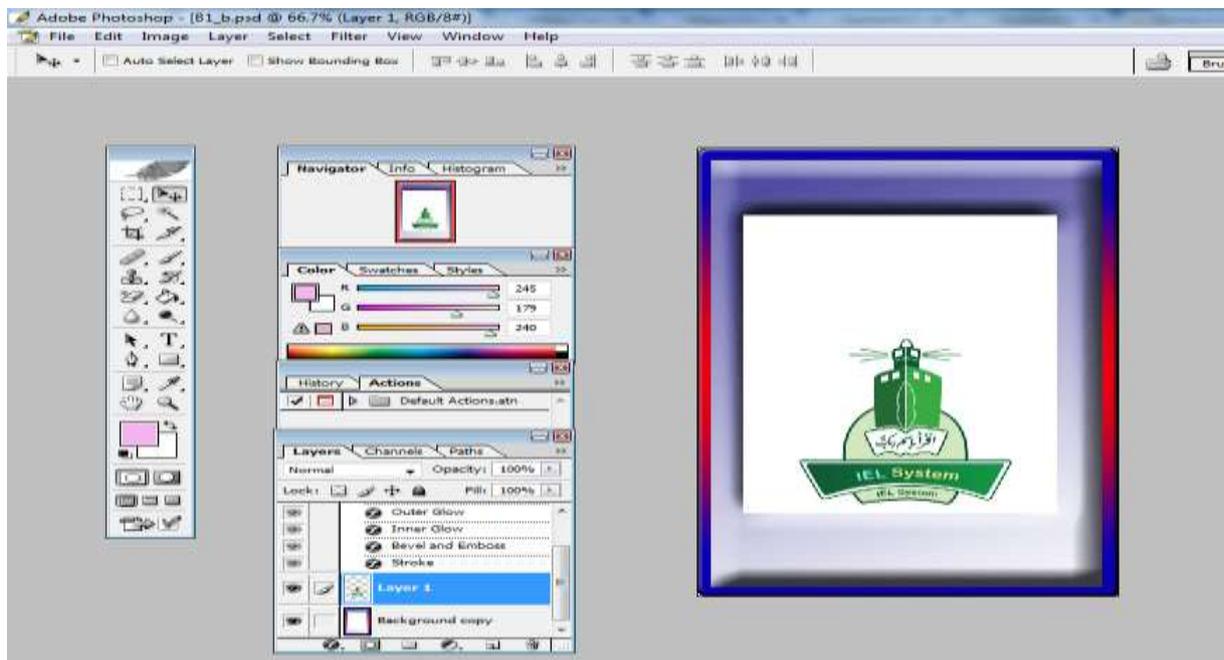


Figure 6-3 : Adobe Photoshop CS8.0 screen design

6.2.1.3.1.2 *Adobe Image Ready CS*

Adobe Image Ready CS 8.0 is a bitmap editor and another tool from Adobe Photoshop that enables the designer to deal with images and create animation. This tool was used to design

and create the IELS logo which appears on the login screen. The logo was designed based on many components such as the KAU logo and the IELS logo. Using Image Ready this logo was animated by gif. Figure 6.4 shows a screen shot of the logo design of the system.



Figure 6-4 : Adobe Image Ready CS system logo design

6.2.1.3.1.3 Dreamweaver CS6

Dreamweaver CS6 was the main tool used in designing the IELS. This tool is a good development web environment which offers rich components that enable the developer or designer to edit, design and view the design at the same time. It includes code editor, a visual design mode and live browser to check whether the design meets the requirements or not. It also supports many web application programming tools such as HTML, PHP, and JavaScript. This means that it provides a comprehensive environment to support the developer in designing and building the application easily. The reason for choosing a basic, simple design is that it can be understood and accessed by anyone. Figure 6.5 shows an example of the Dreamweaver tool that was used to build the IELS.

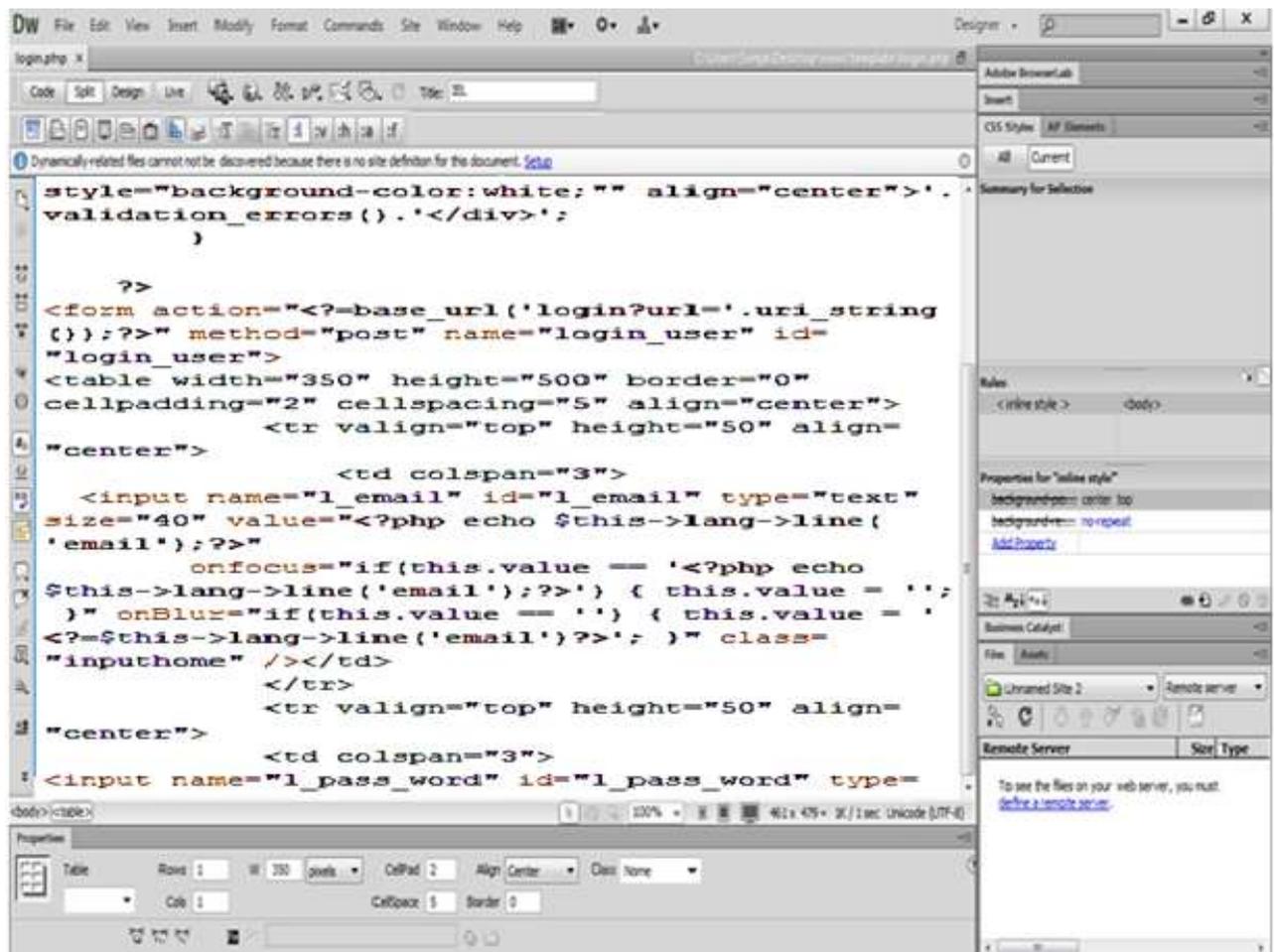


Figure 6-5 : Adobe Dreamweaver system design

6.2.1.4 Development (high level IELS)

The main aspect in this system is to engage students and enhance their level of interactivity with lecture contents; therefore two kinds of action were built and developed, Popup action and Click action. These actions offer students working with the IELS a sort of competition to achieve the learning outcomes. The lecturer will view the contents of a short video clip to identify the main points in the video clip that they wish to ask students about. Then they will find the exact time in the clip in seconds at which to ask each question; for example, point one starts at 1.20 and ends at 2.45, point two starts at 3.55 and ends at 4.28 and so on. The IELS records all students' responses.

Popup actions appear randomly; they show students a statement and they are then required to click Yes or No. All responses will be registered in the students' records, even if they ignore the response system, as right, wrong or ignored.

In Click action a different technique is used. All the statements appear when the video clip is run, and students have to click on the Click button at the exact time they hear each statement mentioned. As students are limited in the number of clicks they can make in this action, and all the statements are given at the beginning of the video clip, when they exceed the limited number of clicks the Click button will be disabled. The codes for the allocation of the actions during the clip in seconds can be seen in Appendix E and as follows:

```
form action="" method="post">
<script>
function confirmDelete(delUrl) {
  if (confirm("<?=$this->lang->line('delete_message');?>")) {
    document.location = delUrl;
  }
}
</script>
<?php echo validation_errors();?>
<div style="overflow-y: scroll;overflow-x: hidden;max-height:320px;max-width:330px;">
<table width="330">
<?
```

Students watch each video clip without knowing when they will be required to answer each question, both in Popup action and in Click action. This may motivate them and keep them focussed on the video clip content. In Click action the system will display the Click button but there is a limit to the number of clicks which can be made. Once students have viewed the first video clip and interacted with its content the IELS will save all their actions in their record and show the percentage of their interactivity, which may encourage them to do better with the next video clip and so on. Also the IELS will keep updating the students' records and their level of interactivity. Figure 6.7 shows the Click action code.

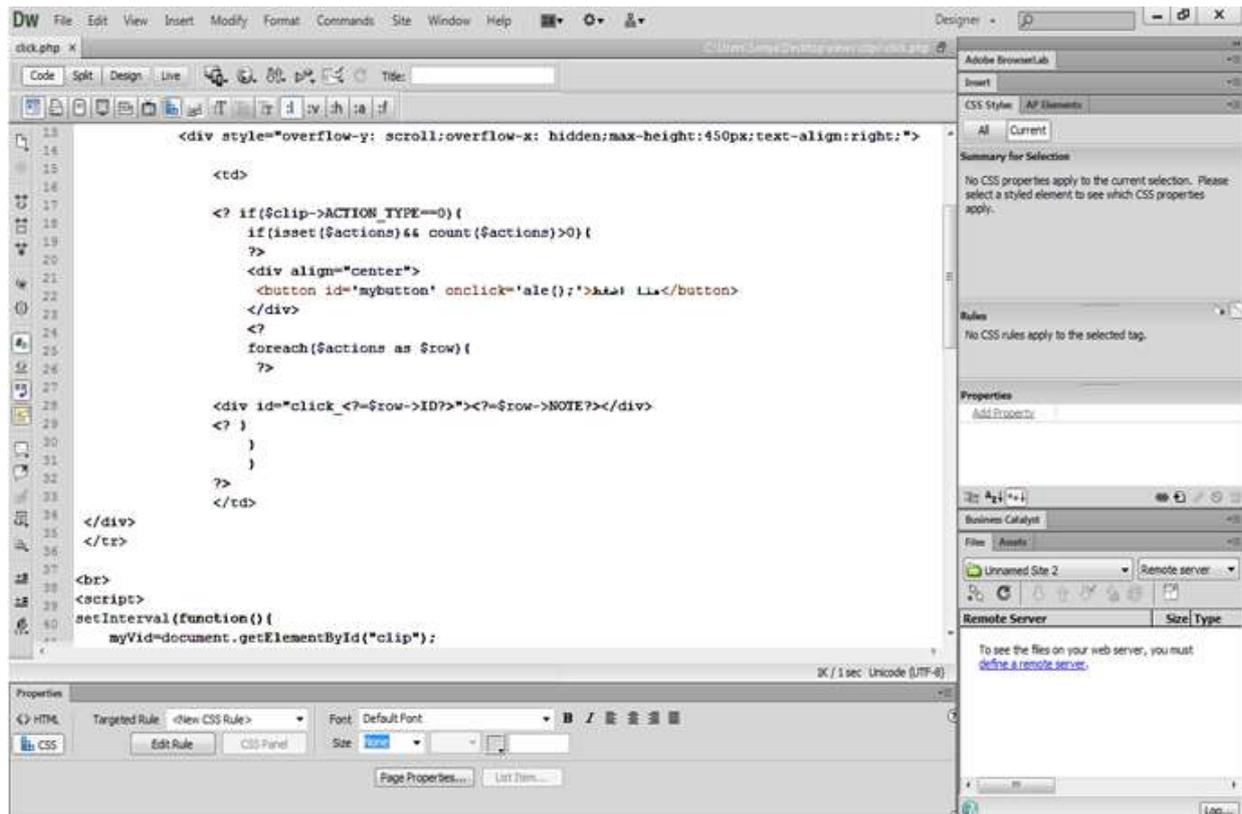


Figure 6-6 : Click action code

After students have seen the video clip they are given a chat link which allows them to communicate with each other, or with their lecturer, to discuss any issue they may have with regard to the content of the clip. The chat area gives the students the chance to express their opinions without any commitment or obligation. This chat will also be saved in their accounts so that they might benefit from it when needed. Chat code can be seen as follows.

```

<script>
window.setInterval(function(){
$("#messagesDiv").load("/clips/Get_comments_stream/<?=$this->uri->segment(3);?>");
}, 1000);
</script>
<script>
$(document).keypress(function(e) {
if(e.which == 13) {

```

```
form_data = {
comment: $('#comment').val(),
    }
$.ajax({
url:"<?=base_url("clips/add_comment_stream/" . $this->uri->segment(3));?>",
type: 'post',
data:form_data,
success: function(){
$("#messagesDiv").load("/clips/Get_comments_stream/<?=$this->uri->segment(3);?>");
document.getElementById('comment').value = "";
    }
});

$(document).ready(function(){

$("#post").click(function(){
form_data = {
comment: $('#comment').val(),
    }
$.ajax({
url:"<?=base_url("clips/add_comment_stream/" . $this->uri->segment(3));?>",
type: 'post',
data:form_data,
success: function(){
$("#messagesDiv").load("/clips/Get_comments_stream/<?=$this->uri->segment(3);?>");
document.getElementById('comment').value = "";
    }
});
```

```
    });  
    $('#clear_all').click(function(){  
    $.ajax({  
    url:"<?=base_url("clips/clear_all/".$this->uri->segment(3));?>",  
    type: 'post',  
    success: function(){  
    $('#messagesDiv').load("/clips/Get_comments_stream/<?=$this->uri->segment(3);?>");  
    document.getElementById('comment').value = "";  
    }  
    });  
    });  
    });  
    });
```

6.2.1.4.1 *IELS database requirements*

In order to build a dynamic application it is necessary to connect that application with the database. With regard to the database, the domain server of the IELS offers the popular database, MySQL version 4.0.8. Based on preliminary study conducted and analysing the users' requirements, it was agreed that user requirements data should be designed. Some details held on IELS system are:

- 1- The course, including course id, course name, and course logo. Each course is given a course ID, which is unique throughout the system.
- 2- The Lecture, which consists of lecture ID, lecture name, lecture logo. Each lecture is given a unique number among the lectures.
- 3- System includes Video Clip that indicates to Clip Id, Clip name, Clip views; every clip has a unique id.

To model the details of the IELS system an entity relationship diagram can be used as seen in Figure 6.7:

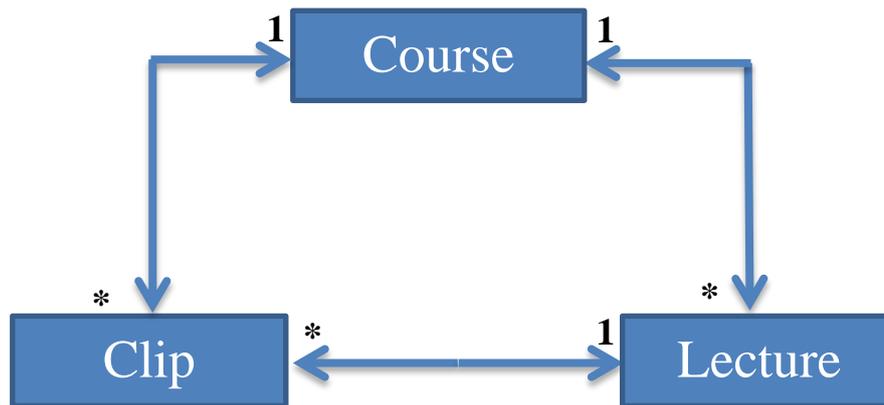


Figure 6-7 ER Diagram for IELS

Entities relationships can be modelled as follows:

- *One to one (1:1)* 1 ↔ 1
- *One to many (1:M)* 1 ↔ *
- *Many to many (M:M)* * ↔ *

The main entities of the IELS system are shown in Table 6.2

Entity	Identifier
Course	Course ID
Lecture	Lecture ID
Clip	Clip ID
Action	Action ID
User	User ID

Table 6-2 : IELS Main Entity

Table 6.3 shows the Relationships between the entities

Relationship	Entity Pair	Degree
Each course has many lecture	Course: Lecture	1:M
Each lecture has many clip	Lecture: Clip	1:M
Many clips has many Action	Clip : Action	M:M

Table 6-3 Types of relationship between entities

One to one (1:1)

In this type of relationship, an entity is associated with another. For example the primary key of A may be placed as a foreign key in B (but not both).

Many to one (M: 1)

This type is the most common existing relationship. The many-to-one relationship represents a relation among entities in which one occurrence of data in one entity may have one or more occurrences of data in the related entity. For example entity A may have several occurrences of related data in entity B.

Many- to-many (M: M)

A many-to-many relationship exists if multiple occurrences of related data are allowed to exist between two entities, in either direction. For example entity A may have many occurrences of related data in entity B. and entity B may have many occurrences of related data in entity A.

IELS entities were identified and translated into tables such as course, lecture, lecturer, users, clip, action, etc. These are some tables were created on MySQL for the IELS system and can be seen as follows.

Table structure for table `course`

```
CREATE TABLE IF NOT EXISTS `course` (
  `ID` int(11) NOT NULL AUTO_INCREMENT,
  `NAME` varchar(50) NOT NULL,
  `DESCRIPTION` text,
  `LOGO` blob NOT NULL,
  `logo_type` varchar(10) DEFAULT NULL,
  `Modify_date` int(11) NOT NULL,
  `STATUS` tinyint(11) NOT NULL DEFAULT '1',
  PRIMARY KEY (`ID`);
```

6.2.1.4.2 IELS domain server

As this system was designed as a web application that is required to allow users to access the IELS via a URL domain, the URL www.ielsystem.com was registered to navigate to the IELS domain name. This domain permits the transfer of all web application contents and files to the server, allowing the developer to launch the system to be ready for access by users. The developer made many changes when designing the system, so the process of transference needed a tool to transfer the files from the developer's PC to the server. Filezilla Client 3.7.3 was the fast tool used to transfer the IELS files to the server. Figure 6.8 shows a screen shot of files moving between the PC and the server.

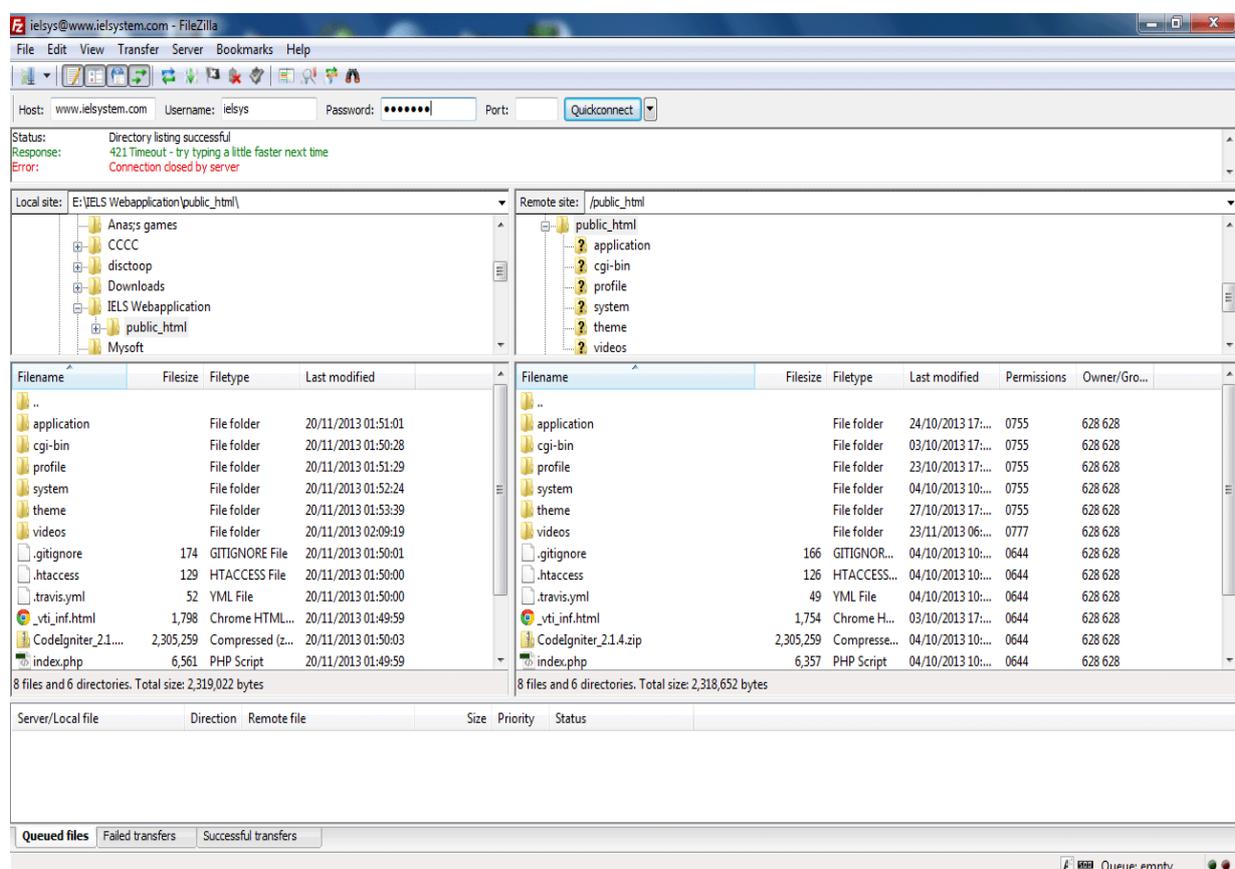


Figure 6-8 : Transfer of IELS files to the server

In this phase the IELS was uploaded to URL www.ielsystem.com to check that it was working smoothly. IELS features and content were tested, such as register as a new user, sign in, sign out, edit personal settings, upload lecture clips, and test the IELS actions. This was also to verify that the system was working properly.

6.2.1.5 Evaluation

Evaluation is the systematic assessment that plays a crucial role in IELS learning design and is intended to improve the whole learning design process and, therefore, continues throughout from the beginning to the end of the entire process. This phase is to ensure that the IELS design meets the needs of the IELS users. Two types of evaluation can be applied in this phase, formative evaluation and summative evaluation, and the effectiveness or weakness of the system can be measured.

Formative evaluation

The aim of applying formative evaluation is to enhance and improve IELS design in each phase of the ADDIE process. It also helps to present the IELS to reach the final version according to the user's need. According to this type of evaluation, IELS was subjected to some changes, such as style of the application, colours, icons, navigation and so on, as a result of some users' feedback or from an expert review.

Summative evaluation

The focus of summative evaluation for the IELS was to see how the system itself presents the lecture content in a motivated way and supports the learning process in a novel style. It also aimed to enhance the interactivity between the lecture content and students, and to enhance the communication between the students and their lecturers when the information is exchanged properly. IELS will evaluate the students' engagement with their lecturers and provide easy communication. Figure 6.9 shows the student credit and chat box.

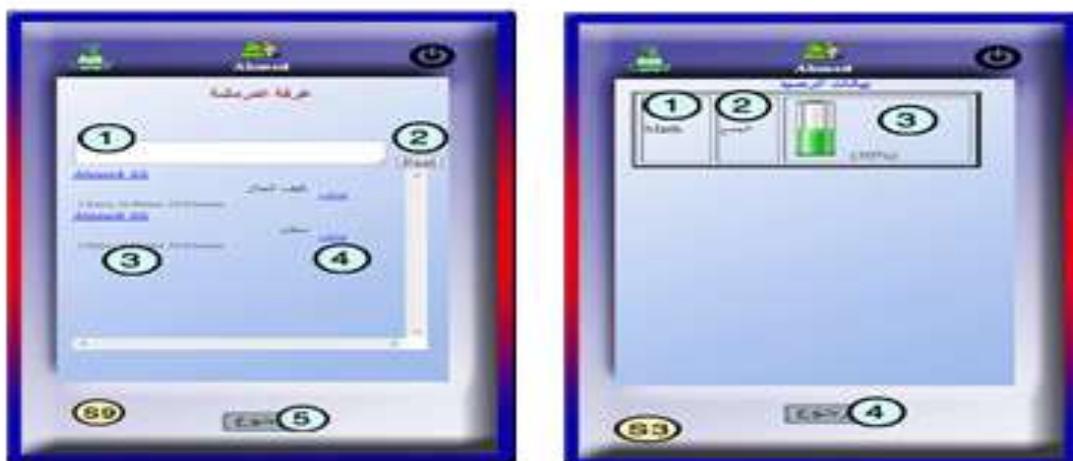


Figure 6-9 : Student credit and chat box

6.3 User Training

Training is a major consideration in today's evolving technology. An important part of the IELS is the end-user, since they are the main focus of the system. End user training should be designed to enable each and every individual user to interact with the IELS interface. An essential aspect of this research is to determine whether the IELS is working properly or not, therefore on-line training was implemented. Some volunteers worked with the IELS to check if it was working properly. The users could then successfully work within a new system environment and also detect any error or bugs that might occur in the IELS. Before the experiment was carried out all participants had to be trained and were offered more than one training session to master use of the system. In that way, after the system was tested and running smoothly the IELS was able to be presented to its users as a real experiment. However, sufficient training was essential to enable them to explore the system's features and work with them easily.

6.4 Conclusion

To summarise, this chapter has outlined how the IELS was implemented. It has also described what tools were used to develop the IELS. All work environments and software such as Dreamweaver, Adobe Photoshop, and MySQL have been described and some programming codes have been specified and shown. In addition, user training of IELS has been outlined.

The following chapter will analyse the main study that was conducted in an effort to identify the variances between e-lecture and the IELS. Quantitative and qualitative methods will be conducted; therefore, two forms of questionnaire will be analysed to check the significant difference between the experiment groups. Research null hypotheses will be tested.

7

Main Study (Data Analysis and Results)

7.1 Introduction

This chapter presents a comprehensive analysis of the main study. It analyses the data collected during the main experiment from the research instruments such as questionnaires, pre-test, post-test and system record. Quantitative and qualitative methods are applied. Quantitative analysis includes the research dimensions, accessibility, usability, interactivity, learnability, communication and satisfaction, as defined in Chapter 1. Also, student learning outcomes, exchange of information between users and students' interaction will be analysed. Qualitative method is applied for open ended questions that were asked at the end of the questionnaires (MQ1 and MQ2) and participants' responses are elaborated and discussed.

7.2 Quantitative Analysis

The statistical package SPSS is the main software used for this analysis as described in Chapter 3 (Section 3.6). Analysis tests were conducted according to the distribution of data, such as the independent t-test and the Mann–Whitney U test. These tests were conducted to find the differences between the user groups who participated in the research experiment. Other tests will be conducted such as Basic Statistic analysis and Paired Sample test.

A level of 0.05 of probability (p) value will be determined as a significant level of difference between samples and to reject or fail to reject the research null hypotheses as determined in Chapter 3 (section 3.3.4). The questionnaires (MQ1 and MQ2) are rated from 1 to 5 (5 = Outstanding, 4 = Good, 3 = Satisfactory, 2 = Poor, 1 = Unsatisfactory) (see Appendix C).

In this section data obtained from the questionnaires will be analysed. Comparisons of analysis between student groups will be conducted and then between lecturer groups. The first comparison will be between IT students using different actions in the IELTS. The second will be between Education students using different actions in the IELTS. The third will

compare all student groups according to department. The final comparison will be between lecturers from the two departments.

7.2.1 Analysis of IT Student groups

7.2.1.1 IELTS accessibility analysis

To analyse and evaluate the IELTS accessibility, Q5 was divided into five statements and given to the IELTS student groups to measure their perceptions of the level of accessibility. (*Does accessibility differ between the IT student groups?*). Table 7.1 shows the statements used to evaluate accessibility. To analyse this question, the null hypothesis NH5.1 was rewritten into five sub null hypotheses according to the accessibility items as shown in Table 7.1.

NH5.1 There is no difference between the means of accessibility from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
A1	It was easy to register with IELTS	<i>NH 5.1.1 There is no difference between the means of being easy to register with IELTS from the perspective of the IT student groups</i>
A2	It was easy to sign in with IELTS	<i>NH 5.1.2 There is no difference between the means of being easy to sign in with IELTS from the perspective of the IT student groups</i>
A3	It was easy to sign out from IELTS	<i>NH 5.1.3 There is no difference between the means of being easy to sign out from IELTS from the perspective of the IT student groups</i>
A4	It was easy to run the IELTS	<i>NH 5.1.4 There is no difference between the means of being easy to run the IELTS from the perspective of the IT student groups</i>
A5	It was easy to access the content of IELTS	<i>NH 5.1.5 There is no difference between the means of ease of access to the IELTS content from the perspective of the IT student groups</i>

Table 7-1 : Statements of Q5 and sub null hypotheses (IT groups)

7.2.1.1.1 Normality distribution test

The Shapiro-Wilk test was used to determine normal distribution of data to measure the accessibility of the IELTS between student groups. Table 7.2 show that the *p value* is greater

than 0.05, and thus accessibility was normally distributed for all items; therefore a parametric test must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
A1	It was easy to register with IELTS	(B1) Popup	8	0.522
		(B2) Click	8	0.067
A2	It was easy to sign in to IELTS	(B1) Popup	8	0.408
		(B2) Click	8	0.067
A3	It was easy to sign out from IELTS	(B1) Popup	8	0.522
		(B2) Click	8	0.067
A4	It was easy to run IELTS	(B1) Popup	8	0.522
		(B2) Click	8	0.067
A5	It was easy to access the content of IELTS	(B1) Popup	8	0.408
		(B2) Click	8	0.067

Table 7-2 : Normality distribution test for IELTS accessibility (IT groups)

Figure 7.1 shows the curve of normality distribution for item A1.

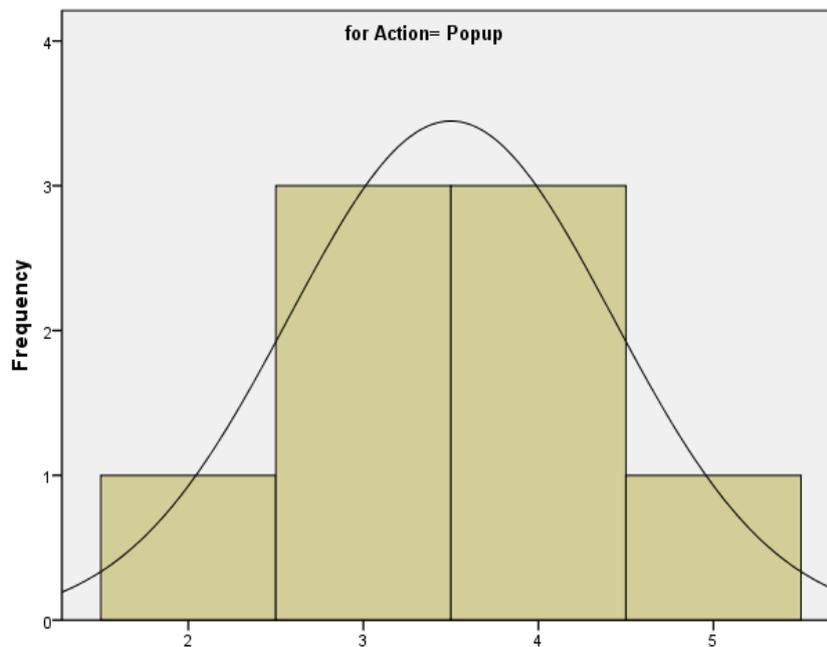


Figure 7-1: Normality distribution curve for item A1

7.2.1.1.2 *Basic statistical analysis*

Table 7.3 shows the basic analysis that includes the means and the standard deviation for the IT groups. It shows that the average mean for group B2 was 3.88 which was slightly higher than the mean of group B1 which was 3.6. Therefore the overall result for students' perceptions of the accessibility of the IELTS was a mean of 3.74 which is close to *Good*.

Item	Statement	Actions	N	Mean	Std. Deviation
A1	It was easy to register with IELTS	(B1)Popup	8	3.50	0.926
		(B2) Click	8	3.88	0.835
A2	It was easy to sign in to IELTS	(B1)Popup	8	3.75	1.035
		(B2) Click	8	3.88	0.835
A3	It was easy to sign out from IELTS	(B1)Popup	8	3.50	0.926
		(B2) Click	8	3.88	0.835
A4	It was easy to run IELTS	(B1)Popup	8	3.50	0.926
		(B2) Click	8	3.88	0.835
A5	It was easy to access the content of IELTS	(B1)Popup	8	3.75	1.035
		(B2) Click	8	3.88	0.835
Average mean of B1 3.6 Average mean of B2 3.88					

Table 7-3 : Means of accessibility for student groups Popup and Click (IT groups)

7.2.1.1.3 *Independent t-test*

According to the results shown in Table 7.2, the distribution for IELTS accessibility is normal. Independent t-tests were used to compare the IT groups B1 and B2, and to answer research question Q5, as well as to examine the accessibility sub null hypotheses shown in Table 7.1 and determine whether they would be rejected or fail to be rejected. If the *p value* is smaller than 0.05 ($p \leq 0.05$) it is significant and the sub null hypothesis will be rejected, whereas if the *p value* is greater than .05 ($p > 0.05$) it means there is no significance and the sub null hypothesis will fail to be rejected.

Item	Statement	t	df	Sig. (<i>p value</i>)
A1	It was easy to register with IELTS	-0.851	14	0.409
A2	It was easy to sign in with IELTS	-0.266	14	0.794
A3	It was easy to sign out from IELTS	-0.851	14	0.409
A4	It was easy to run IELTS	-0.851	14	0.409
A5	It was easy to access IELTS content	-0.266	14	0.794

Table 7-4 : Independent sample t-test for IELTS accessibility (IT groups)

Table 7.4 Shows that the actual means are not significantly different between the IT student groups for all items, because the values in the "Sig. (*p value*)" column are not below the significance level of 0.05. Therefore there are no significant differences between the means of the IT groups when they access the IELTS. This leads us to fail to reject the sub null hypotheses as shown in Table 7.5.

Sub null hypotheses	Result
NH5.1 There is no difference between the means of accessibility to the IELTS from the perspective of the IT student groups	Fail to Reject
<i>NH 5.1.1 There is no difference between the means of being easy to register with IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 5.1.2 There is no difference between the means of being easy to sign in with IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 5.1.3 There is no difference between the means of being easy to sign out from IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 5.1.4 There is no difference between the means of being easy to run the IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 5.1.5 There is no difference between the means of ease of access to the IELTS content from the perspective of the IT student groups</i>	<i>Fail to Reject</i>

Table 7-5 : Sub null hypothesis test result for IELTS accessibility (IT groups)

7.2.1.2 IELTS usability analysis

To analyse and evaluate the IELTS usability, Q6 was divided into seven statements and given to the IELTS student groups to measure their perceptions of the standard of usability. (*Does usability differ between the IT student groups?*). Table 7.6 shows the statements used to evaluate usability. To analyse this question, null hypothesis NH6.1 was rewritten into seven sub null hypotheses according to the usability items as shown in Table 7.6

NH6.1 There is no difference between the means of usability of the IELTS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
U1	It was easy to use the IELTS	<i>NH 6.1.1 There is no difference between the means of using the IELTS from the perspective of the IT student groups</i>
U2	It was easy to edit my personal settings in the IELTS	<i>NH 6.1.2 There is no difference between the means when editing personal settings in the IELTS from the perspective of the IT student groups</i>
U3	It was easy to view my modules using the IELTS	<i>NH 6.1.3 There is no difference between the means when viewing modules using the IELTS from the perspective of the IT student groups</i>

NH6.1 There is no difference between the means of usability of the IELS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
U4	It was easy to view my lectures using the IELS	<i>NH 6.1.4 There is no difference between the means when viewing lectures using the IELS from the perspective of IT student groups</i>
U5	It was easy to view my video clips using the IELS	<i>NH 6.1.5 There is no difference between the means when viewing video clips using the IELS from the perspective of the IT student groups</i>
U6	It was easy to view my credits using the IELS	<i>NH 6.1.6 There is no difference between the means when viewing credits using the IELS from the perspective of the IT student groups</i>
U7	It was easy to navigate using the IELS	<i>NH 6.1.7 There is no difference between the means when navigating using the IELS from the perspective of the IT student groups</i>

Table 7-6 : Statements of Q6 and sub null hypotheses (IT groups)

Figure 7.2 shows the curve of normality distribution for item U2.

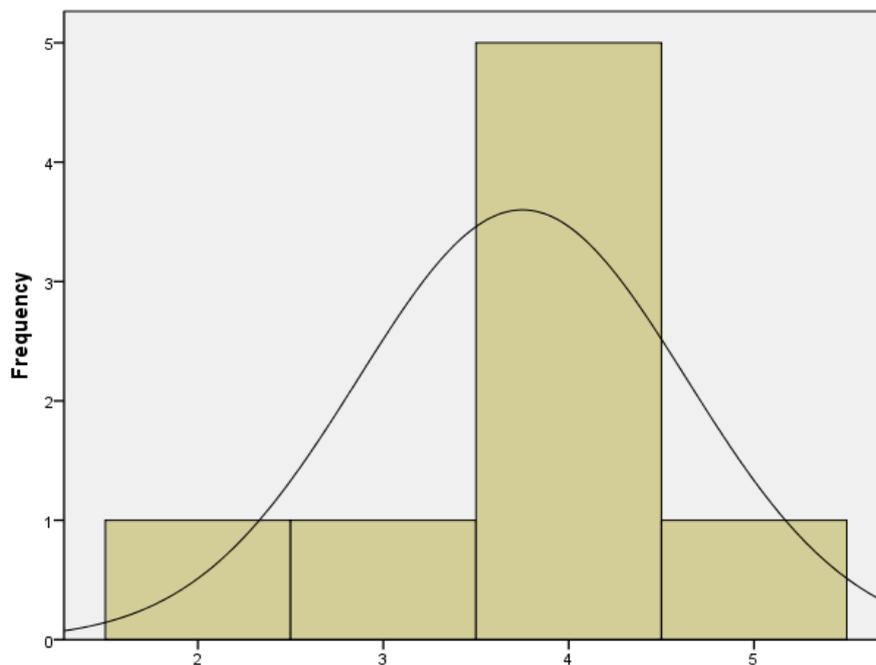


Figure 7-2 : Normality distribution curve for item U2

7.2.1.2.1 Normality distribution test

The Shapiro-Wilk test was used to determine normal distribution of data to measure the usability of the IELTS between the IT student groups. Table 7.7 shows that the *p value* is greater than 0.05, therefore the usability was normally distributed for all items, therefore parametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
U1	It was easy to use the IELTS	(B1) Popup	8	0.324
		(B2) Click	8	0.056
U2	It was easy to edit my personal settings in the IELTS	(B1) Popup	8	0.054
		(B2) Click	8	0.056
U3	It was easy to view my modules using the IELTS	(B1) Popup	8	0.067
		(B2) Click	8	0.067
U4	It was easy to view my lectures using the IELTS	(B1) Popup	8	0.067
		(B2) Click	8	0.067
U5	It was easy to view my video clips using the IELTS	(B1) Popup	8	0.093
		(B2) Click	8	0.056
U6	It was easy to view my credits using the IELTS	(B1) Popup	8	0.120
		(B2) Click	8	0.093
U7	It was easy to navigate using the IELTS	(B1) Popup	8	0.093
		(B2) Click	8	0.067

Table 7-7: Normality distribution test for IELTS usability (IT groups)

7.2.1.2.2 Basic statistical analysis

Table 7.8 shows that the average mean for group B2 was 4.02 which was slightly higher than the mean of group B1 which was 3.93. Therefore the overall result regarding students' attitudes to the usability of the IELTS was a mean of 3.98 which is close to *Good*.

Item	Statement	Actions	N	Mean	Std. Deviation
U1	It was easy to use the IELTS	(B1) Popup	8	3.63	0.916
		(B2) Click	8	3.75	0.707
U2	It was easy to edit my personal settings in the IELTS	(B1) Popup	8	3.75	0.886
		(B2) Click	8	3.75	0.707
U3	It was easy to view my modules using the IELTS	(B1) Popup	8	4.25	0.707
		(B2) Click	8	4.13	0.835
U4	It was easy to view my lectures using the IELTS	(B1) Popup	8	3.88	0.835
		(B2) Click	8	4.13	0.835
U5	It was easy to view my video clips using the IELTS	(B1) Popup	8	4.00	0.756
		(B2) Click	8	4.25	0.641
U6	It was easy to view my credits using the IELTS	(B1) Popup	8	4.00	1.069
		(B2) Click	8	4.00	0.756

Item	Statement	Actions	N	Mean	Std. Deviation
U7	It was easy to navigate using the IELS	(B1) Popup	8	4.00	0.756
		(B2) Click	8	4.13	0.835
		Average mean of B1 3.93	Average mean of B2 4.02		

Table 7-8 : Means of IELS usability of student groups B1 and B2 (IT groups)

7.2.1.2.3 Independent t-test

To compare between the two means to determine whether there is significant difference between the different students groups, B1 and B2, the independent t-test is used. To answer research question Q6 the independent t-test was conducted to examine the usability sub null hypotheses shown in Table 7.10 and determine whether they would be rejected or fail to be rejected.

Item	Statement	t	df	Sig.(p value)
U1	It was easy to use the IELS	-0.306	14	0.764
U2	It was easy to edit my personal settings in the IELS	0.000	14	1.000
U3	It was easy to view my modules using the IELS	0.323	14	0.751
U4	It was easy to view my lectures using the IELS	-0.599	14	0.559
U5	It was easy to view my video clips using the IELS	-0.683	14	0.506
U6	It was easy to view my credits using the IELS	0.000	14	1.000
U7	It was easy to navigate using the IELS	-0.314	14	0.758

Table 7-9 : Independent sample t-test For IELS usability (IT groups)

Table 7.9 Shows that all the p values are greater than 0.05 ($p > 0.05$) and thus there are no significant differences between the means of the IT groups and leads us to fail to reject the null hypothesis as shown in Table 7.10.

Sub null hypotheses	Result
NH 6.1 There is no difference between the means of usability of the IELS from the perspective of the IT student groups	Fail to Reject
<i>NH 6.1.1 There is no difference between the means of ease of using the IELS from the perspective of the IT students groups</i>	Fail to Reject
<i>NH 6.1.2 There is no difference between the means of ease of editing personal settings in the IELS from the perspective of the IT students groups</i>	Fail to Reject
<i>NH 6.1.3 There is no difference between the means of ease of viewing modules using the IELS from the perspective of IT students groups</i>	Fail to Reject
<i>NH 6.1.4 There is no difference between the means of ease of viewing lectures using the IELS from the perspective of the IT students groups</i>	Fail to Reject
<i>NH 6.1.5 There is no difference between the means of ease of viewing</i>	Fail to Reject

Sub null hypotheses	Result
<i>video clips using the IELTS from the perspective of the IT students groups</i>	
<i>NH 6.1.6 There is no difference between the means of ease of viewing credits using the IELTS from the perspective of the IT students groups</i>	Fail to Reject
<i>NH 6.1.7 There is no difference between the means of ease of navigating using the IELTS from the perspective of the IT students groups</i>	Fail to Reject

Table 7-10 : Sub null hypotheses test result for IELTS usability (IT groups)

7.2.1.3 IELTS interactivity analysis

To analyse and evaluate the IELTS interactivity, Q7 was divided into three statements and given to the IELTS student groups to measure their perceptions of the standard of interactivity. (*Does interactivity with the IELTS differ between the IT student groups?*). Table 7.11 shows the statements used to evaluate interactivity. To analyse this question null hypothesis NH7.1 was rewritten into three sub null hypotheses according to the interactivity items as shown in Table 7.11

NH7.1 There is no difference between the means of increased interactivity of the IELTS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
I1	IELS offered me more interactivity with lecture contents than the e-lecture	NH 7.1.1 There is no difference between the means of increased interactivity of the IELTS from the perspective of the IT student groups
I2	IELS actions enhanced my level of engagement	NH 7.1.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the IT student groups
I3	IELS fostered my ability to use technology in the learning process	NH 7.1.3 There is no difference between the means of fostering the ability to learn from the perspective of the IT student groups

Table 7-11 : Statements of Q7 and sub null hypotheses (IT groups)

7.2.1.3.1 Normality distribution test

The Shapiro-Wilk test was used to determine normal distribution to measure the interactivity of the IELTS between student groups. Table 7.12 shows that the *p value* is greater than 0.05, and thus the interactivity was normally distributed for all items, therefore parametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
I1	IELS offered me more interactivity with lecture contents than the e-lecture	(B1) Popup	8	0.324
		(B2) Click	8	0.056

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
I2	IELS actions enhanced my level of interactivity	(B1) Popup	8	0.093
		(B2) Click	8	0.156
I3	IELS fostered my ability to use technology in the learning process	(B1) Popup	8	0.522
		(B2) Click	8	0.054

Table 7-12 : Normality distribution test for IELS interactivity (IT groups)

Figure 7.3 shows the curve of normality distribution for item I3.

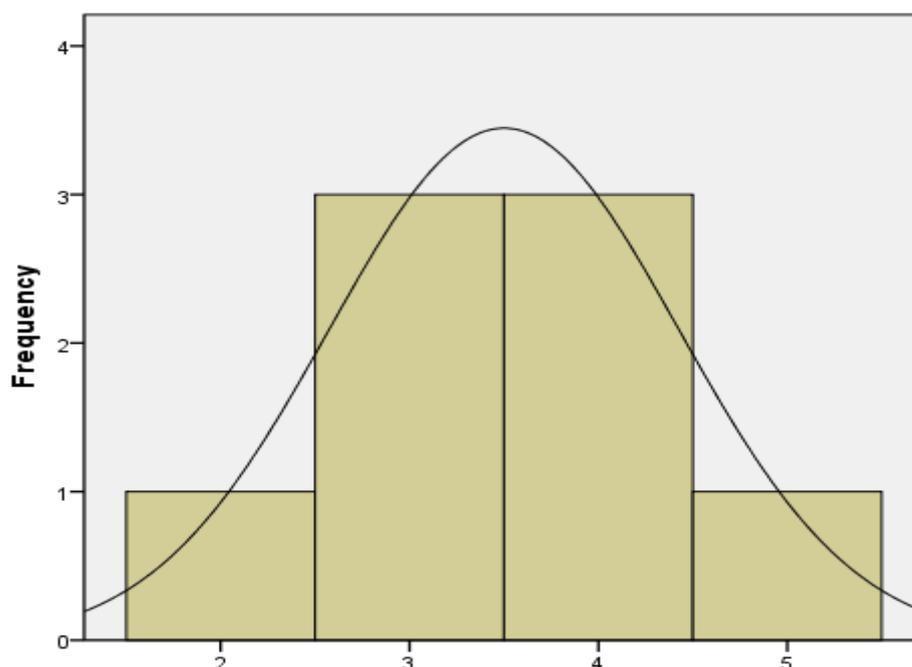


Figure 7-3 : Normality distribution curve for item I3

7.2.1.3.2 Basic statistical analysis

Table 7.13 shows that the average mean for B2 was 3.79, slightly higher than the mean of B1 which was 3.71. The overall result for students' perceptions of the interactivity of the IELS was a mean of 3.75 which is close to *Good*.

Item	Statement	Actions	N	Mean	Std. Deviation
I1	IELS offered me more interactivity with lecture contents than the e-lecture	(B1)Popup	8	3.63	0.916
		(B2) Click	8	3.75	0.707
I2	IELS actions enhanced my level of interactivity	(B1)Popup	8	4.00	0.756
		(B2) Click	8	3.88	0.991
I3	IELS fostered my ability to use technology in the learning process	(B1)Popup	8	3.50	0.926
		(B2) Click	8	3.75	0.886

Item	Statement	Actions	N	Mean	Std. Deviation
Average mean of B1		3.71		Average mean of B2 3.79	

Table 7-13 : Means of IELTS interactivity of student groups B1 and B2 (IT groups)

7.2.1.3.3 *Independent t-test*

To compare between two means to establish whether there is significant difference between the different students groups the independent t-test was used. To answer the research question Q7 an independent t-test was also conducted to examine the interactivity null hypotheses as shown in Table 7.15 and determine whether they would be rejected or fail to be rejected.

Item	Statement	t	df	Sig. (<i>p value</i>)
I1	IELS offered me more interactivity with lecture contents than the e-lecture	-0.306	14	0.764
I2	IELS actions enhanced my level of interactivity	0.284	14	0.781
I3	IELS fostered my ability to use technology in the learning process	-0.552	14	0.590

Table 7-14 : Independent sample t-test for IELTS interactivity (IT groups)

Table 7.14 Shows that all the *p values* are greater than 0.05 ($p > 0.05$) and thus there are no significant differences between the means of the IT groups and leads us to fail to reject the null hypotheses as shown in Table 7.15.

Sub null hypotheses	Result
NH7.1 There is no difference between the means of interactivity of the IELTS from the perspective of the IT student groups	Fail to Reject
<i>NH7.1.1 There is no difference between the means of interactivity of the IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH7.1.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH7.1.3 There is no difference between the means of fostering the ability to learn from the perspective of the IT student groups</i>	<i>Fail to Reject</i>

Table 7-15 : Sub null hypotheses test result for IELTS interactivity (IT groups)

7.2.1.4 IELTS learnability analysis

To analyse and evaluate the IELTS learnability, Q8 was divided into five statements and given to the IELTS students groups to measure their perceptions of the standard of learnability. (*Does learnability of the IELTS differ between the IT groups?*). Table 7.16 shows the statements used to evaluate learnability. To analyse this question null hypothesis NH8.1 were

rewritten into four null hypotheses according to the questionnaire items as shown in Table 7.16.

NH8.1 There is no difference between the means of learnability of the IELTS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
L1	It was easy to learn from the IELTS	NH 8.1.1 There is no difference between the means of ease of learning from the IELTS from the perspective of the IT student groups
L2	IELS actions are easy to learn from	NH 8.1.2 There is no difference between the means of ease of learning from action (Click or Popup) from the perspective of the IT student groups
L3	IELS offered learning to me at any time as wanted	NH 8.1.3 There is no difference between the means of learning at any time from the IELTS from the perspective of the IT student groups
L4	IELS facilitated the learning process	NH 8.1.4 There is no difference between the means of facilitating the learning process from the perspective of the IT student groups

Table 7-16 : Statements of Q8 and null hypotheses (IT groups)

7.2.1.4.1 Normality distribution test

The Shapiro-Wilk test was used to determine normal distribution to measure the learnability of the IELTS between students groups. Table 7.17 shows that the *p value* is greater than 0.05, which means the learnability was normally distributed for all items, therefore parametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
L1	It was easy to learn from the IELTS	(B1) Popup	8	0.056
		(B2) Click	8	0.067
L2	IELS actions are easy to learn from	(B1) Popup	8	0.324
		(B2) Click	8	0.056
L3	IELS offered learning to me for any time as wanted	(B1) Popup	8	0.324
		(B2) Click	8	0.093
L4	IELS facilitates the learning process	(B1) Popup	8	0.324
		(B2) Click	8	0.324
L5	IELS offered me more learning than the e-lecture	(B1) Popup	8	0.067
		(B2) Click	8	0.067

Table 7-17 : Normality distribution for IELTS learnability (IT groups)

Figure 7.4 shows the curve of normality distribution for item L5.

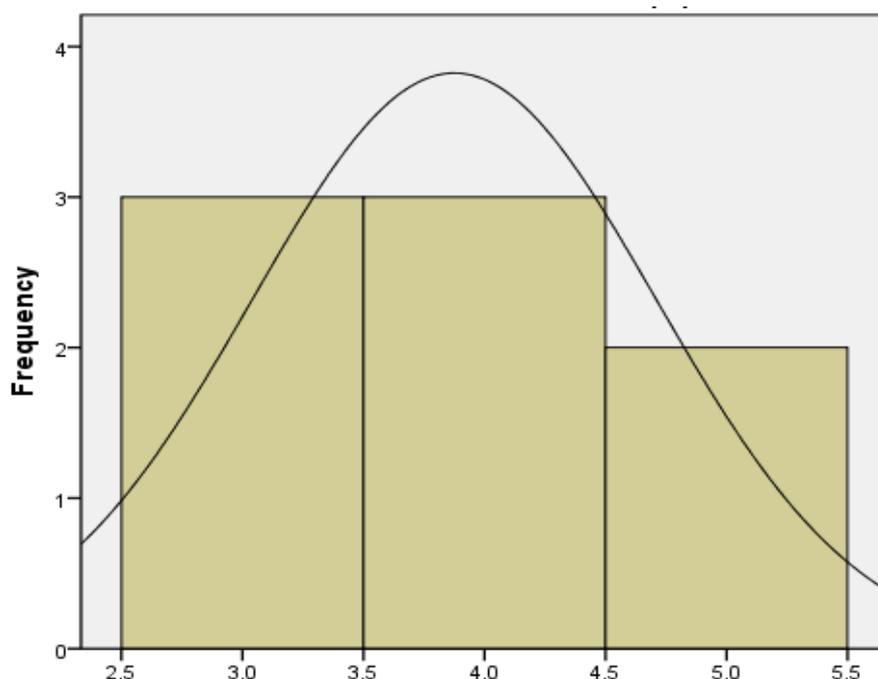


Figure 7-4 : Normality distribution curve for item L5

7.2.1.4.2 Basic statistical analysis

7.18 Shows that the average mean for B2 was 3.83, which was slightly higher than the mean of B1 which was 3.65. The overall result for students' perceptions of the accessibility of the IELS was a mean of 3.74 which is close to *Good*.

Item	Statement	Actions	N	Mean	Std. Deviation
L1	It was easy to learn from the IELS	(B1)Popup	8	3.75	0.707
		(B2)Click	8	3.88	0.835
L2	IELS actions are easy to learn from	(B1)Popup	8	3.38	0.916
		(B2)Click	8	3.75	0.707
L3	IELS offered learning to me at any time as wanted	(B1)Popup	8	3.63	0.916
		(B2)Click	8	4.00	0.756
L4	IELS facilitates the learning process	(B1)Popup	8	3.63	0.916
		(B2)Click	8	3.63	0.916
L5	IELS offered me more learning than the e-lecture	(B1)Popup	8	3.88	0.835
		(B2)Click	8	3.88	0.835
Average mean of B1 3.65 Average means of B2 3.83					

Table 7-18 : Means of learnability of student groups B1 and B2 (IT groups)

7.2.1.4.3 *Independent t-test*

To compare between two means to establish whether there is significant difference between the different students groups the independent t-test was used. To answer the research question Q8 the independent t-test was conducted to examine the learnability null hypotheses as shown in Table 3.16 and determine whether they would be rejected or fail to be rejected.

Item	Statement	t	df	Sig. (<i>p value</i>)
U1	It was easy to learn from the IELTS	-0.323	14	0.751
L2	ILEA actions are easy to learn from the IELTS	-0.917	14	0.375
L3	IELS offered learning to me at any time as wanted	-0.893	14	0.387
L4	IELS facilitates the learning process	0.000	14	1.000
L5	IELS offered me more learning than the e-lecture	0.000	14	1.000

Table 7-19 : Independent sample t-test for IELTS learnability (IT groups)

Table 7.19 shows that all *p values* are greater than 0.05 ($p > 0.05$) and thus there are no significant differences between the means of the IT groups and leads us to fail to reject the null hypothesis as shown in Table 7.20.

Sub null hypotheses	Result
NH8.1 There is no difference between the means of learnability of the IELTS from the perspective of the IT students groups	Fail to Reject
<i>NH8.1.1 There is no difference between the means of ease of learning from the IELTS from the perspective of the IT students groups</i>	<i>Fail to Reject</i>
<i>NH8.1.2 There is no difference between the means of ease of learning from action (Click or Popup) from the perspective of the IT students groups</i>	<i>Fail to Reject</i>
<i>NH8.1.3 There is no difference between the means of learning at any time from the IELTS from the perspective of the IT students groups</i>	<i>Fail to Reject</i>
<i>NH8.1.4 There is no difference between the means of facilitating the learning process from the perspective of the IT students groups</i>	<i>Fail to Reject</i>
<i>NH8.1.5 There is no difference between the means of IELTS offering more learning than the e-lecture from the perspective of the IT students groups</i>	<i>Fail to Reject</i>

Table 7-20 : Sub null hypotheses test result for IELTS learnability (IT groups)

7.2.1.5 **IELS communication analysis**

To analyse and evaluate IELTS communication, Q9 was divided into four statements and given to the IELTS student groups to measure their perceptions of the standard of communication. (*Does users' communication differ between the IT student groups?*). Table 7.21 shows the statements used to evaluate communication. To analyse this question, null hypothesis NH9.1

was rewritten into four sub null hypotheses according to the communication items as shown in Table 7.21.

NH9.1 There is no difference between the means of communication via the IELTS from the perspective of the IT student groups		
	Statement	Sub null hypotheses
C1	It was easy to communicate with my lecturer using the IELTS	<i>NH 9.1.1 There is no difference between the means of easy communication with lecturer via the IELTS from the perspective of the IT student groups</i>
C2	It was easy to get feedback from my lecturer using the IELTS	<i>NH 9.1.2 There is no difference between the means of getting easy feedback via the IELTS from the perspective of the IT student groups</i>
C3	It was easy to send messages to any user via IELTS	<i>NH 9.1.3 There is no difference between the means of being easy to send messages via the IELTS from the perspective of the IT student groups</i>
C4	It was easy to chat with any user via IELTS	<i>NH 9.1.4 There is no difference between the means of being easy to chat via the IELTS from the perspective of the IT student groups</i>

Table 7-21 : Statements of Q9 and sub null hypotheses (IT groups)

7.2.1.5.1 **Normality distribution test**

To determine normality of distribution to measure the means of communication of the IELTS between student groups B1 and B2 the Shapiro-Wilk test was used. Table 7.22 shows that the *p value* is greater than 0.05, and thus the communication was normally distributed for all items, therefore parametric tests will be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
C1	It was easy to communicate with my lecturer using the IELTS	(B1) Popup	8	0.522
		(B2) Click	8	0.067
C2	It was easy to get feedback from my lecturer using the IELTS	(B1) Popup	8	0.366
		(B2) Click	8	0.067
C3	It was easy to send message to any user via IELTS	(B1) Popup	8	0.522
		(B2) Click	8	0.093
C4	It was easy to chat with any user via IELTS	(B1) Popup	8	0.324
		(B2) Click	8	0.156

Table 7-22 : Normality of distribution test for IES communication (IT groups)

Figure 7.5 shows the curve of normality distribution for item C2.

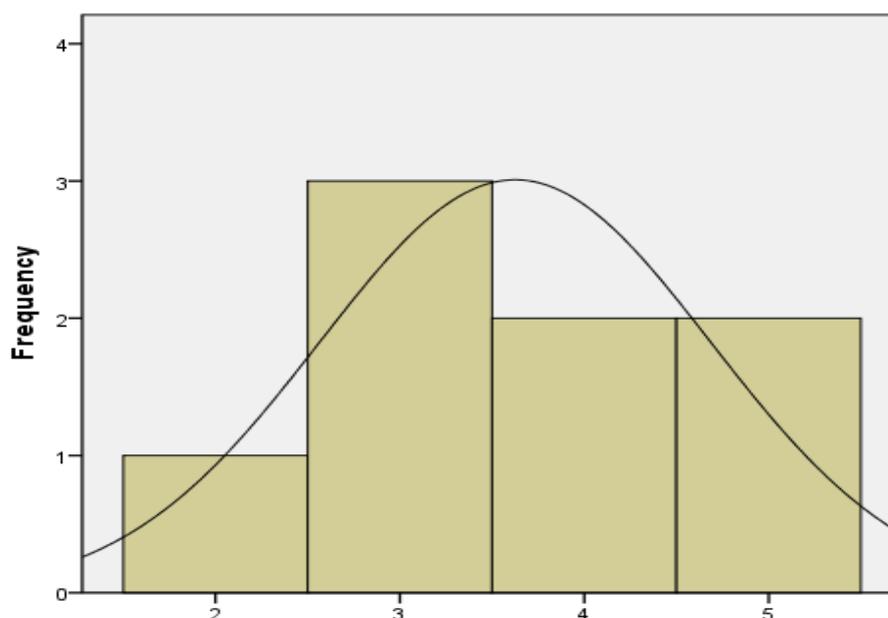


Figure 7-5 : Normality distribution curve for item C2

7.2.1.5.2 *Basic statistical analysis*

Table 7.23 shows that the average mean for B2 was 3.97, which was slightly higher than the mean of B1 which was 3.50. The overall result for students' perceptions regarding communication using the IELS was a mean of 3.74 which is close to *Good*.

Item	Statement	Actions	N	Mean	Std. Deviation
C1	It was easy to communicate with my lecturer using the IELS	(B1) Popup	8	3.50	0.926
		(B2) Click	8	3.88	0.835
C2	It was easy to get feedback from my lecturer using the IELS	(B1) Popup	8	3.63	1.061
		(B2) Click	8	4.13	0.835
C3	It was easy to send messages to any user via IELS	(B1) Popup	8	3.50	0.926
		(B2) Click	8	4.00	0.756
C4	It was easy to chat with any user via IELS	(B1) Popup	8	3.38	0.916
		(B2) Click	8	3.88	0.991
Average mean of B1 3.50		Average mean of B2 3.97			

Table 7-23 : Means of communication for IT student groups

7.2.1.5.3 *Independent t-test*

To compare between the two means to establish whether there is significant difference between students groups the independent t-test was used. To answer research question Q9 the independent t-test was also conducted to examine the communication null hypotheses as shown in Table 7.25 and determine whether they would be rejected or fail to be rejected.

Item	Statement	t	df	Sig. (p value)
C1	It was easy to communicate with my lecturer using the IELS	-0.851	14	0.409
C2	It was easy to get feedback from my lecturer using the IELS	-1.048	14	0.312
C3	It was easy to send messages to any user via IELS	-1.183	14	0.256
C4	It was easy to chat with any user via IELS	-1.048	14	0.312

Table 7-24 : Independent sample t-test for IELS communication (IT groups)

Table 7.24 shows that all *p values* are greater than 0.05 ($p > 0.05$) and thus there are no significant differences between the means of the IT groups and leads us to fail to reject the null hypothesis as shown in Table 7.25.

Sun null hypotheses	Result
NH 9.1 There is no difference between the means of communication via the IELS from the perspective of the IT student groups	Fail to Reject
<i>NH 9.1.1 There is no difference between the means of easy communication with the lecturer via the IELS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 9.1.2 There is no difference between the means of getting easy feedback via the IELS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 9.1.3 There is no difference between the means of being easy to send messages via the IELS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 9.1.4 There is no difference between the means of being easy to chat via the IELS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>

Table 7-25 : Sub null hypotheses test result for IELS communication (IT groups)

7.2.1.6 IELS satisfaction analysis

To analyse and evaluate IELS communication, Q10 was divided into eight statements and given to the IELS student groups to measure their perspectives of the level of satisfaction. (*Does satisfaction differ between the IT student groups?*). Table 7.26 shows the statements used to evaluate communication. To analyse this question null hypothesis NH10.1 was rewritten into eight sub null hypotheses according to the satisfaction items as shown in Table 7.26.

NH10.1 There is no difference between the means of satisfaction when using the IELS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
S1	Dividing lectures into clips is better than delivering the whole lecture at once	<i>NH 10.1.1 There is no difference between the means of dividing the lecture into clips when using the IELS from the perspective of the IT student groups</i>
S2	Video clips' time duration was appropriate	<i>NH 10.1.2 There is no difference between the means of video clips' time duration when using the IELS from the perspective of the IT student groups</i>

S3	IELS style presents a lecture in a new format to me	<i>NH 10.1.3 There is no difference between the means of new format of the IELS from the perspective of the IT student groups</i>
S4	IELS style interface designs are familiar to me	<i>NH 10.1.4 There is no difference between the means of familiarity with interface designs from the perspective of the IT student groups</i>
S5	IELS style interface colours are familiar to me	<i>NH 10.1.5 There is no difference between the means of familiarity with interface colours from the perspective of the of IT student groups</i>
S6	IELS style multimedia is familiar to me	<i>NH 10.1.6 There is no difference between the means of familiarity with style multimedia from the perspective of the IT student groups</i>
S7	I am satisfied with IELS operation	<i>NH 10.1.7 There is no difference between the satisfaction of means of IELS operation from the perspective of IT student groups</i>
S8	I am satisfied with IELS speed	<i>NH10.1.8 There is no difference between the means of IELS speed from the perspective of IT student groups</i>

Table 7-26 : Statements of Q10 and sub null hypotheses (IT groups)

7.2.1.6.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality distribution to measure the satisfaction of the IELS between student groups. Table 7.27 shows that the *p value* is greater than 0.05, and thus the satisfaction was normally distributed for items S7 and S8, therefore parametric tests must be used. However, for items S1, S2, S3, S4,S5 and S6, Table 7.27 shows that the *p value* is lower than 0.05, and thus the satisfaction was not normally distributed, therefore nonparametric tests must be used.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
S1	Dividing lectures into clips is better than delivering the whole lecture at once	(B1) Popup	8	0.027
		(B2) Click	8	0.000
S2	Video clips' time duration was appropriate	(B1) Popup	8	0.027
		(B2) Click	8	0.000
S3	IELS style presents a lecture in a new format to me	(B1) Popup	8	0.027
		(B2) Click	8	0.000
S4	IELS style interface designs are familiar to me	(B1) Popup	8	0.018
		(B2) Click	8	0.000
S5	IELS style interface colours are familiar to me	(B1) Popup	8	0.002
		(B2) Click	8	0.000
S6	IELS style multimedia is familiar to me	(B1) Popup	8	0.004
		(B2) Click	8	0.000
S7	I am satisfied with IELS operation	(B1) Popup	8	0.324
		(B2) Click	8	0.067
S8	I am satisfied with IELS speed	(B1) Popup	8	0.324
		(B2) Click	8	0.093

Table 7-27 : Normality distribution test for IELS satisfaction (IT groups)

Figure 7.6 shows the curve of normality distribution for item S5.

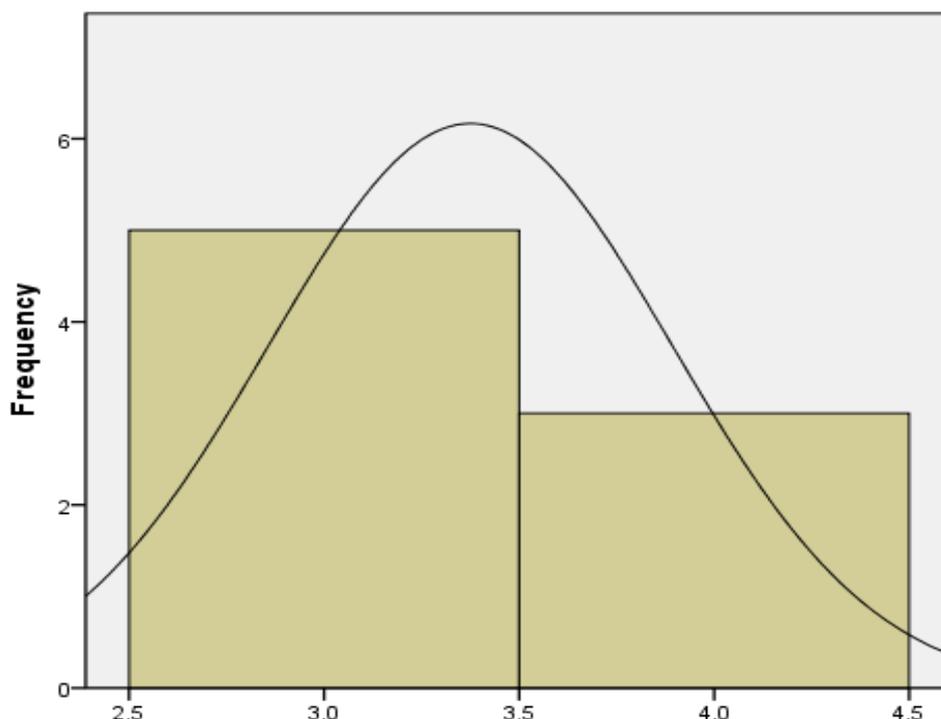


Figure 7-6 : Normality distribution curve for item S5

7.2.1.6.2 *Basic statistical analysis*

Table 7.28 shows that the average mean for B2 was 3.55 which was slightly higher than the mean of B1 which was 3.44. The overall result for the IT student groups regarding satisfaction when using the IELS was a mean of 3.50 which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
S1	Dividing lectures into clips is better than delivering the whole lecture at once	(B1)Popup	8	3.38	0.744
		(B2)Click	8	3.38	0.518
S2	Video clips' time duration was appropriate	(B1)Popup	8	3.38	0.744
		(B2)Click	8	3.38	0.518
S3	IELS style presents a lecture in a new format to me	(B1)Popup	8	3.38	0.744
		(B2)Click	8	3.38	0.518
S4	IELS style interface designs are familiar to me	(B1)Popup	8	3.25	0.886
		(B2)Click	8	3.38	0.518
S5	IELS style interface colours are familiar to me	(B1)Popup	8	3.38	0.916
		(B2)Click	8	3.38	0.518
S6	IELS style multimedia is familiar to me	(B1)Popup	8	3.50	0.756
		(B2)Click	8	3.38	0.518
S7	I am satisfied with IELS operation	(B1)Popup	8	3.63	0.916

Item	Statement	Actions	N	Mean	Std. Deviation
		(B2)Click	8	4.13	0.835
S8	I am satisfied with IELS speed	(B1)Popup	8	3.63	0.916
		(B2)Click	8	4.00	0.756
		Average mean of B1 3.44		Average mean of B2 3.55	

Table 7-28 : Means of satisfaction of IT student groups

7.2.1.6.3 Independent t-test

To compare between two means to determine whether there is significant difference between the student groups, the independent t-test was used with regards items S1, S2, S3, S4,S5 and S6. In order to answer the research question Q10 the independent t-test was also conducted to examine the satisfaction null hypotheses as shown in Table 7.31 and determine whether they would be rejected or fail to be rejected.

Item	Statement	t	df	Sig. (<i>p value</i>)
S1	Dividing lectures into clips is better than delivering the whole lecture at once	0.000	14	1.000
S2	Video clips' time duration was appropriate	0.000	14	1.000
S3	IELS style presents a lecture in a new format to me	0.000	14	1.000
S4	IELS style interface designs are familiar to me	0.000	14	1.000
S5	IELS style interface colours are familiar to me	0.000	14	1.000
S6	IELS style multimedia is familiar to me	0.386	14	0.706

Table 7-29 : Independent sample t-test for IELS satisfaction

Table 7.29 shows that all the *p values* are greater than the level of 0.05 ($p > 0.05$) and thus there is no significant difference between the IT groups for item S1,S2,S3,S4,S5 and S6.

7.2.1.6.4 Mann-Whitney U test

Item	Statement	Mann-Whitney U	Sig. (<i>p value</i>)	Action	N	Mean Rank
S7	I am satisfied with IELS operation	22.500	0.290	(B1)Popup	8	7.31
				(B2)Click	8	9.69
S8	I am satisfied with IELS speed	25.000	0.427	(B1)Popup	8	7.63
				(B2)Click	8	9.38

Table 7-30 : Mann-Whitney U test for IELS satisfaction (IT groups)

According to the independent t-test and Mann Whitney U-test that were conducted to test the null hypotheses for the level of satisfaction of IT student groups, Table 7.29 and Table 7.30

show that the p values for all items are larger than the significance level of 0.05 which means there are no significant differences between the means of the two IT groups. This leads us to conclude that all null hypotheses fail to be rejected as shown in Table 7.31.

Sub null hypotheses	Test
NH10.1 There is no difference between the means of satisfaction when using the IELTS from the perspective of the IT student groups	Fail to Reject
<i>NH 10.1.1 There is no difference between the means of dividing lectures into clips when using the IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.2 There is no difference between the means of video clips' time duration when using the IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.3 There is no difference between the means of new format of the IELTS from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.4 There is no difference between the means of familiarity of interface designs from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.5 There is no difference between the means of familiarity of interface colours from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.6 There is no difference between the means of familiarity of style multimedia from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH 10.1.7 There is no difference between the means of IELTS operation from the perspective of the IT student groups</i>	<i>Fail to Reject</i>
<i>NH10.1.8 There is no difference between the means of IELTS operation from the perspective of the IT student groups</i>	<i>Fail to Reject</i>

Table 7-31 : Sub null hypotheses test result for IELTS satisfaction (IT groups)

7.2.2 Analysis of Education Student Groups

7.2.2.1 IELTS accessibility analysis

(Does accessibility differ between the Education student groups?) To examine and evaluate the Education student groups' perceptions of access to the IELTS, null hypothesis NH5.2 was rewritten into five sub null hypotheses as shown in Table 7.32.

NH5.2 There is no difference between the means of accessibility to the IELTS from the perspective of the Education student groups		
Item	Statement	Sub null hypotheses
A1	It was easy to register with IELTS	<i>NH 5.2.1 There is no difference between the means of being easy to register with the IELTS from the perspective of the Education student groups</i>
A2	It was easy to sign in with IELTS	<i>NH 5.2.2 There is no difference between the means of being easy to sign in with IELTS from the perspective of the Education student groups</i>
A3	It was easy to sign out from IELTS	<i>NH 5.2.3 There is no difference between the means of being easy to sign out from the IELTS from the perspective of the Education student groups</i>
A4	It was easy to run the IELTS	<i>NH 5.2.4 There is no difference between the means of being easy to run the IELTS from the perspective of the Education student groups</i>
A5	It was easy to access the contents of IELTS	<i>NH 5.2.5 There is no difference between the means of ease of access to its content from the perspective of the Education student groups</i>

Table 7-32 : Statements of Q5 and sub null hypotheses (Education groups)

7.2.2.1.1 Normality distribution test

To determine what type of test would be used to examine the significance level of accessibility to the IELTS application between the Education groups (C1 and C2), normality distribution tests were conducted. Table 7.33 shows that all the items were below the significance level of 0.05. This indicates that the data for all items were not normally distributed between the Education groups.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (p value)
A1	It was easy to register with IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.000
A2	It was easy to sign in to IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.037
A3	It was easy to sign out from IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.037

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
A4	It was easy to run IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.000
A5	It was easy to access the content of IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.037

Table 7-33 : Normality distribution test for IELTS accessibility (Education groups)

7.2.2.1.2 *Basic statistical analysis*

The result for the Education student groups regarding their perceptions of accessing the IELTS was a mean of 3.88, which is close to *Good* for group C1, while it was a mean of 2.83 for group C2, which is close to *Satisfactory*. Therefore the overall result for both groups was a mean of 3.36 which is between *Good* and *Satisfactory*.

Item	Statement	Action	N	Mean	Std. Deviation
A1	It was easy to register with IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.75	0.463
A2	It was easy to sign in to IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.88	0.641
A3	It was easy to sign out from IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.88	0.641
A4	It was easy to run IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.75	0.463
A5	It was easy to access the content of IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.88	0.641
Average mean of Popup 3.88 Average mean of Click 2.83					

Table 7-34 : Means of accessibility for student groups C1 and C2 (Education groups)

7.2.2.1.3 *Mann-Whitney U test*

As an examination of the findings in Table 7.35 shows, there is a highly significant difference between group C1 and group C2 in items A1 and A4 as the mean rank for group C1 is 11.75, while the mean rank for C2 is 5.25. For items A2, A3 and A5 there is a significant difference between both groups as the mean rank for group C1 is 11.31, while the mean rank for C2 is 5.69.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p value</i>)	Action	N	Mean Rank
A1	It was easy to register with IELTS	6.000	-2.969	0.003	Popup	8	11.75
					Click	8	5.25
A2	It was easy to sign in with IELTS	9.500	-2.541	0.011	Popup	8	11.31
					Click	8	5.69
A3	It was easy to sign out	9.500	-2.541	0.011	Popup	8	11.31

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p value</i>)	Action	N	Mean Rank
	from IELTS				Click	8	5.69
A4	It was easy to run IELTS	6.000	-2.969	0.003	Popup	8	11.75
					Click	8	5.25
A5	It was easy to access the content of IELTS	9.500	-2.541	0.011	Popup	8	11.31
					Click	8	5.69

Table 7-35 : Mann-Whitney U test for IELTS accessibility (Education groups)

Overall, Table 7.35 shows that there is a significant difference between the means of accessibility of the Education student groups which indicates rejection of the sub null hypotheses as presented in Table 7.36.

Sub null hypotheses	Result
NH 5.2 There is no difference between the means of accessibility to the IELTS from the perspective of the Education student groups	Reject
<i>NH 5.2.1 There is no difference between the means of being easy to register with the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 5.2.2 There is no difference between the means of being easy to sign in with the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 5.2.3 There is no difference between the means of being easy to sign out from the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 5.2.4 There is no difference between the means of being easy to run the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 5.2.5 There is no difference between the means of ease of access to its content from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-36 : Sub null hypotheses test result for IELTS accessibility (Education groups)

7.2.2.2 IELTS usability analysis

To examine and evaluate the usability of the Education student groups when using the IELTS application, null hypothesis NH6.2 was rewritten into seven sub null hypotheses and stated as shown in Table 7.37.

NH6.2 There is no difference between the means of usability of the IELTS from the perspective of the Education student groups		
item	Statement	Sub null hypotheses
U1	It was easy to use the IELTS	<i>NH 6.2.1 There is no difference between the means of using the IELTS from the perspective of the Education student groups</i>
U2	It was easy to edit my personal settings in the IELTS	<i>NH 6.2.2 There is no difference between the means when editing personal settings in the IELTS from the perspective of the Education student groups</i>
U3	It was easy to view my modules	<i>NH 6.2.3 There is no difference between the means</i>

NH6.2 There is no difference between the means of usability of the IELS from the perspective of the Education student groups		
item	Statement	Sub null hypotheses
	using the IELS	<i>when viewing modules using the IELS from the perspective of the Education student groups</i>
U4	It was easy to view my lectures using the IELS	<i>NH 6.2.4 There is no difference between the means when viewing lectures using the IELS from the perspective of the Education student groups</i>
U5	It was easy to view my video clips using the IELS	<i>NH 6.2.5 There is no difference between the means when viewing video clips using the IELS from the perspective of the Education student groups</i>
U6	It was easy to view my credits using the IELS	<i>NH 6.2.6 There is no difference between the means when viewing credits using the IELS from the perspective of the Education student groups</i>
U7	It was easy to navigate using the IELS	<i>NH 6.2.7 There is no difference between the means when navigating using the IELS from the perspective of the Education student groups</i>

Table 7-37 : Statements of Q6 and sub null hypotheses (Education groups)

7.2.2.2.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the usability of the IELS between students groups C1 and C2. Table 7.38 shows that the *p value* is lower than 0.05, which means usability was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
U1	It was easy to use the IELS	(C1) Popup	8	0.037
		(C2) Click	8	0.037
U2	It was easy to edit my personal settings in the IELS	(C1) Popup	8	0.005
		(C2) Click	8	0.000
U3	It was easy to view my modules using the IELS	(C1) Popup	8	0.005
		(C2) Click	8	0.000
U4	It was easy to view my lectures using the IELS	(C1) Popup	8	0.037
		(C2) Click	8	0.000
U5	It was easy to view my video clips using the IELS	(C1) Popup	8	0.005
		(C2) Click	8	0.000
U6	It was easy to view my credits using the IELS	(C1) Popup	8	0.005
		(C2) Click	8	0.000
U7	It was easy to navigate using the IELS	(C1) Popup	8	0.005
		(C2) Click	8	0.000

Table 7-38 : Normality distribution test for IELS usability (Education groups)

7.2.2.2.2 *Basic statistical analysis*

Table 7.39 shows the result for the Education student groups regarding their perceptions of using the IELTS was mean of 3.97, which is close to *Good* for C1 group, and a mean of 2.75 for group C2, which is close to *Satisfactory*. Therefore the overall result for both groups was a mean of 3.36 which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
U1	It was easy to use the IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.88	0.641
U2	It was easy to edit my personal settings in the IELTS	(C1) Popup	8	4.00	0.535
		(C2) Click	8	2.75	0.463
U3	It was easy to view my modules using the IELTS	(C1) Popup	8	4.00	0.535
		(C2) Click	8	2.75	0.463
U4	It was easy to view my lectures using the IELTS	(C1) Popup	8	3.88	0.641
		(C2) Click	8	2.75	0.463
U5	It was easy to view my video clips using the IELTS	(C1) Popup	8	4.00	0.535
		(C2) Click	8	2.63	0.518
U6	It was easy to view my credits using the IELTS	(C1) Popup	8	4.00	0.535
		(C2) Click	8	2.75	0.463
U7	It was easy to navigate using the IELTS	(C1) Popup	8	4.00	0.535
		(C2) Click	8	2.75	0.463
		Average mean of Popup 3.97		Average mean of Click 2.75	

Table 7-39 : Means of IELTS usability of student groups C1 and C2 (Education groups)

7.2.2.2.3 *Mann-Whitney U test*

The results of the findings in Table 7.40 show there is a highly significant difference between group C1 and group C2 in items U2, U3, U6, with a mean rank of 12.13 for C1 and a mean rank of 4.88 for C2.

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Action	N	Mean Rank
U1	It was easy to use the IELTS	9.500	-2.541	0.011	(C1) Popup	8	11.31
					(C2) Click	8	5.69
U2	It was easy to edit my personal settings in the IELTS	3.000	-3.275	0.001	(C1) Popup	8	12.13
					(C2) Click	8	4.88
U3	It was easy to view my modules using the IELTS	3.000	-3.275	0.001	(C1) Popup	8	12.13
					(C2) Click	8	4.88
U4	It was easy to view my lectures using the IELTS	6.000	-2.969	0.003	(C1) Popup	8	11.75
					(C2) Click	8	5.25
U5	It was easy to view my video	2.500	-3.282	0.001	(C1) Popup	8	12.19

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Action	N	Mean Rank
	clips using the IELS				(C2) Click	8	4.81
U6	It was easy to view my credits using the IELS	3.000	-3.275	0.001	(C1) Popup	8	12.13
					(C2) Click	8	4.88
U7	It was easy to navigate using the IELS	3.000	-3.275	0.001	(C1) Popup	8	12.13
					(C2) Click	8	4.88

Table 7-40 : Mann-Whitney U test for IELS usability (Education groups)

Overall, Table 7.40 shows that there is a significant difference between the means of usability of the Education groups which indicates a rejection of the sub null hypotheses as presented in Table 7.41.

Sub null hypotheses	Result
NH6.2 There is no difference between the means of usability of the IELS from the perspective of the Education student groups	Reject
<i>NH6.2.1 There is no difference between the means of using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.2 There is no difference between the means when editing personal settings in the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.3 There is no difference between the means when viewing modules using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.4 There is no difference between the means when viewing lectures using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.5 There is no difference between the means when viewing video clips using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.6 There is no difference between the means when viewing credits using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH6.2.7 There is no difference between the means when navigating using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-41 : Sub null hypotheses test result for IELS usability (Education groups)

7.2.2.3 IELS interactivity analysis

Does interactivity with the IELS differ between the Education student groups? To examine and evaluate the perceptions of the Education student groups regarding interactivity when using the IELS application, null hypothesis NH7.2 was rewritten into three sub null hypotheses as shown in Table 7.42.

NH7.2 There is no difference between the means of interactivity of the IELS from the perspective of the Education student groups		
Item	Statement	Null hypotheses
I1	IELS offered me more interactivity with lecture contents than the e-lecture	NH7.2.1 There is no difference between the means of interactivity of the IELS from the perspective of the Education student groups
I2	IELS actions enhanced my level of interactivity	NH7.2.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the Education student groups
I3	IELS fostered my ability to use technology in the learning process	NH7.2.3 There is no difference between the means of fostering the ability of learning from the perspective of the Education student groups

Table 7-42 : Statements of Q7 and sub null hypotheses (Education groups)

7.2.2.3.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the interactivity of the IELS between students groups C1 and C2. Table 7.43 shows that the *p value* is lower than 0.05, which means the interactivity was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
I1	IELS offered me more interactivity with lecture contents than the e-lecture	(C1)Popup	8	0.037
		(C2) Click	8	0.005
I2	IELS actions enhanced my level of interactivity	(C1)Popup	8	0.037
		(C2) Click	8	0.005
I3	IELS fostered my ability to use technology in the learning process	(C1)Popup	8	0.037
		(C2) Click	8	0.005

Table 7-43 : Normality distribution for IELS interactivity (Education groups)

7.2.2.3.2 Basic statistical analysis

Table 7.44 shows the result for the Education student groups regarding their perceptions of interactivity when using the IELS application was a mean of 3.88, which is close to *Good* for C1 Group, and a mean of 3.00 for Group C2, which is close to *Satisfactory*. Therefore the overall result for both groups was a mean of 3.44 which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
I1	IELS offered me more interactivity with lecture contents than the e-lecture	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.00	0.535
I2	IELS actions enhanced my level of interactivity	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.00	0.535
I3	IELS fostered my ability to use	(C1)Popup	8	3.88	0.641

technology in the learning process	(C2)Click	8	3.00	0.535
Average mean of Popup 3.88		Average mean of Click 3.00		

Table 7-44 : Means of IELTS interactivity of student groups C1 and C2 (Education groups)

7.2.2.3.3 Mann-Whitney U test

Table 7.45 shows there is a significant difference between group C1 and group C2 in all items and the mean rank for group C1 is 11.19, while the mean rank for C2 is 5.81.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Action	N	Mean Rank
I1	IELS offered me more interactivity with lecture contents than the e-lecture	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81
I2	IELS actions enhanced my level of interactivity	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81
I3	IELS fostered my ability to use technology in the learning process	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81

Table 7-45 : Mann-Whitney U test For IELTS interactivity (Education groups)

Overall, Table 7.45 shows that there is a significant difference between the means of interactivity of the Education groups which indicates rejection of the null hypotheses as presented in Table 7.46.

Sub null hypotheses	Result
NH 7.2 There is no difference between the means of interactivity of the IELTS from the perspective of the Education student groups	Reject
<i>NH 7.2.1 There is no difference between the means of interactivity of the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 7.2.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 7.2.3 There is no difference between the means of fostering the ability of learning from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-46 : Sub null hypothesis test result for IELTS interactivity (Education groups)

7.2.2.4 IELTS learnability analysis

Does learnability of the IELTS differ between the Education student groups? To examine and evaluate the learnability between the Education student groups when using the IELTS application, null hypothesis NH8.2 was rewritten into five sub null hypotheses as shown in Table 7.47.

NH8.2 There is no difference between the means of learnability of the IELS from the perspective of the Education student groups		
Item	Statement	Null hypotheses
L1	It was easy to learn from the IELS	<i>NH 8.2.1 There is no difference between the means of being easy to learn from the IELS from the perspective of the Education student groups</i>
L2	IELS actions are easy to learn from	<i>NH 8.2.2 There is no difference between the means of being easy to learn from action (Click or Popup) from the perspective of the Education student groups</i>
L3	IELS offered learning to me at any time as wanted	<i>NH 8.2.3 There is no difference between the means of learning at any time from the IELS from the perspective of the Education student groups</i>
L4	IELS facilitated the learning process	<i>NH 8.2.4 There is no difference between the means of facilitating the learning process from the perspective of the Education student groups</i>
L5	IELS offered me more learning than the e-lecture	<i>NH 8.2.5 There is no difference between the means of IELS offering more learning from the IELS from the perspective of the Education student groups</i>

Table 7-47 : Statements of Q8 and null hypotheses (Education groups)

7.2.2.4.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the learnability of the IELS between student groups C1 and C2. Table 7.48 shows that the *p value* is lower than 0.05, which means the learnability was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
L1	It was easy to learn from the IELS	(C1) Popup	8	0.000
		(C2) Click	8	0.005
L2	IELS actions are easy to learn from	(C1) Popup	8	0.037
		(C2) Click	8	0.005
L3	IELS offered learning to me at any time as wanted	(C1) Popup	8	0.027
		(C2) Click	8	0.000
L4	IELS facilitates the learning process	(C1) Popup	8	0.037
		(C2) Click	8	0.000
L5	IELS offered me more learning than the e-lecture	(C1) Popup	8	0.005
		(C2) Click	8	0.000

Table 7-48 : Normality distribution for IELS learnability (Education groups)

7.2.2.4.2 Basic statistical analysis

Table 7.49 shows the result for the Education student groups regarding their perception of learnability when using the IELS application was a mean of 3.96, which is close to *Good* for

group C1, and a mean of 3.00 for group C2, which is close to *Satisfactory*. Therefore the overall result for both groups was a mean of 3.47 which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
L1	It was easy to learn from the IELTS	(C1) Popup	8	3.75	0.463
		(C2) Click	8	3.00	0.535
L2	IELS actions are easy to learn from	(C1) Popup	8	4.13	0.641
		(C2) Click	8	3.00	0.535
L3	IELS offered learning to me for any time as wanted	(C1) Popup	8	3.63	0.744
		(C2) Click	8	2.88	0.354
L4	IELS facilitated the learning process	(C1) Popup	8	4.13	0.641
		(C2) Click	8	2.88	0.354
L5	IELS offered me more learning than the e-lecture	(C1) Popup	8	4.00	0.535
		(C2) Click	8	3.25	0.463
Average mean of C1 3.93 Average means of C2 3.00					

Table 7-49 : Means of learnability of student groups C1 and C2 (Education groups)

7.2.2.4.3 Mann-Whitney U test

The findings in Table 7.50 show there is a significant difference between group C1 and group C2 in items L1 with the mean rank for group C1 at 11.13, while the mean rank for C2 is 5.88.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Action	N	Mean Rank
L1	It was easy to learn from the IELTS	11.000	-2.475	0.013	(C1) Popup	8	11.13
					(C2) Click	8	5.88
L2	IELS actions are easy to learn from	6.500	-2.880	0.004	(C1) Popup	8	11.69
					(C2) Click	8	5.31
L3	IELS offered learning to me for any time as wanted	14.000	-2.308	0.021	(C1) Popup	8	10.75
					(C2) Click	8	6.25
L4	IELS facilitated the learning process	3.500	-3.255	0.001	(C1) Popup	8	12.06
					(C2) Click	8	4.94
L5	IELS offered me more learning than the e-lecture	11.000	-2.475	0.013	(C1) Popup	8	11.13
					(C2) Click	8	5.88

Table 7-50 : Mann-Whitney U test for IELTS learnability (Education groups)

Overall, Table 7.50 shows that there is a significant difference between the means of learnability of the Education student groups which indicates rejection of the null hypotheses as presented in Table 7.51.

Sub null hypotheses	Result
NH8.2 There is no difference between the means of learnability of the IELTS from the perspective of the Education student groups	Reject
<i>NH 8.2.1 There is no difference between the means of ease of learning from the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 8.2.2 There is no difference between the means of ease of learning from action (Click or Popup) from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 8.2.3 There is no difference between the means of learning any time from the IELTS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 8.2.4 There is no difference between the means of facilitating the learning process from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-51 : Sub null hypotheses test result for IELTS learnability (Education groups)

7.2.2.5 IELTS communication analysis

(Does users' communication differ between the Education student groups?). To examine and evaluate the communication between the Education student groups when using the IELTS application, null hypothesis NH9.2 was rewritten into four sub null hypotheses as shown in Table 7.52.

NH9.2 There is no difference between the means of communication via the IELTS from the perspective of Education student groups		
Item	Statement	Null hypotheses
C1	It was easy to communicate with my lecturer using the IELTS	<i>NH 9.2.1 There is no difference between the means of ease of communication with lecturer via the IELTS from the perspective of the Education student groups</i>
C2	It was easy to get feedback from my lecturer using the IELTS	<i>NH 9.2.2 There is no difference between the means of getting easy feedback via the IELTS from the perspective of the Education student groups</i>
C3	It was easy to send messages to any user via IELTS	<i>NH 9.2.3 There is no difference between the means of being easy to send messages via the IELTS from the perspective of the Education student groups</i>
C4	It was easy to chat with any user via IELTS	<i>NH 9.2.4 There is no difference between the means of being easy to chat via the IELTS from the perspective of the Education student groups</i>

Table 7-52 : Statements of Q9 and null hypotheses (Education groups)

7.2.2.5.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the communication of the IELTS between student groups C1 and C2. Table 7.53 shows that the p

value is lower than 0.05, which means communication was not normally distributed for all items; therefore nonparametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
C1	It was easy to communicate with my lecturer using the IELTS	(C1) Popup	8	0.000
		(C2) Click	8	0.005
C2	It was easy to get feedback from my lecturer using the IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.005
C3	It was easy to send messages to any user via IELTS	(C1) Popup	8	0.000
		(C2) Click	8	0.005
C4	It was easy to chat with any user via IELTS	(C1) Popup	8	0.037
		(C2) Click	8	0.000

Table 7-53 : Normality distribution test for IES communication (Education groups)

7.2.2.5.2 *Basic statistical analysis*

Table 7.54 shows the result for the Education student groups in terms of their perceptions regarding communication when using the IELTS application was a mean of 3.94, which is close to *Good* for C1 Group, and a mean of 3.03 for Group C2, which is close to *Satisfactory*. Therefore the overall result for both groups was a mean of 3.49 which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
C1	It was easy to communicate with my lecturer using the IELTS	(C1)Popup	8	3.75	0.463
		(C2)Click	8	3.00	0.535
C2	It was easy to get feedback from my lecturer using the IELTS	(C1)Popup	8	4.13	0.641
		(C2)Click	8	3.00	0.535
C3	It was easy to send messages to any user via IELTS	(C1)Popup	8	3.75	0.463
		(C2)Click	8	3.00	0.535
C4	It was easy to chat with any user via IELTS	(C1)Popup	8	4.13	0.641
		(C2)Click	8	3.13	0.354
Average mean of C1 is 3.94			Average mean of C2 is 3.03		

Table 7-54 : Means of communication of student groups C1 and C2 (Education groups)

7.2.2.5.3 *Mann-Whitney U test*

Table 7.55 shows there is a significant difference between Group C1 and Group C2 in all items such as C1 and C3 with a mean rank for Group C1 of 11.13, while the mean rank for Group C2 is 5.88.

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Action	N	Mean Rank
C1	It was easy to communicate with my lecturer using the IELS	11.000	-2.475	0.013	(C1)Popup	8	11.13
					(C2)Click	8	5.88
C2	It was easy to get feedback from my lecturer using the IELS	6.500	-2.880	0.004	(C1)Popup	8	11.69
					(C2)Click	8	5.31
C3	It was easy to send messages to any user via IELS	11.000	-2.475	0.013	(C1)Popup	8	11.13
					(C2)Click	8	5.88
C4	It was easy to chat with any user via IELS	7.000	-2.893	0.004	(C1)Popup	8	11.63
					(C2)Click	8	5.38

Table 7-55 : Mann-Whitney U test for IELS communication (Education groups)

Overall, Table 7.55 shows that there is a significant difference between the means of communication of the Education groups which indicates rejection of the null hypotheses as presented in Table 7.56.

Sub null hypotheses	Result
NH 9.2 There is no difference between the means of communication via the IELS from the perspective of the Education student groups	Reject
<i>NH 9.2.1 There is no difference between the means of ease of communication with lecturer via the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 9.2.2 There is no difference between the means of ease of getting feedback via the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 9.2.3 There is no difference between the means of being easy to send messages via the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 9.2.4 There is no difference between the means of being easy to chat via the IELS from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-56 : Sub null hypotheses test result for IELS communication (Education groups)

7.2.2.6 IELS satisfaction analysis

(Does satisfaction differ between the Education student groups?). To examine and evaluate the satisfaction between the Education student groups when using the IELS application, null hypothesis NH10.2 was rewritten into eight null hypotheses as shown in Table 7.57.

NH10.2 There is no difference between the means of satisfaction when using the IELS from the perspective of the Education student groups		
Item	Statement	Sub null hypotheses
S1	Dividing lectures into clips is better than delivering the whole lecture at once	<i>NH 10.2.1 There is no difference between the means of dividing lectures into clips when using the IELS from the perspective of the Education student groups</i>
S2	Video clips' time duration was appropriate	<i>NH 10.2.2 There is no difference between the means of video clips' time duration when using the IELS from the</i>

NH10.2 There is no difference between the means of satisfaction when using the IELTS from the perspective of the Education student groups		
Item	Statement	Sub null hypotheses
		<i>perspective of the Education student groups</i>
S3	IELS style presents a lecture in a new format to me	<i>NH 10.2.3 There is no difference between the means of new format of the IELTS from the perspective of the Education student groups</i>
S4	IELS style interface designs are familiar to me	<i>NH 10.2.4 There is no difference between the means of familiarity with interface designs from the perspective of the Education student groups</i>
S5	IELS style interface colours are familiar to me	<i>NH 10.2.5 There is no difference between the means of familiarity with interface colours from the perspective of the Education student groups</i>
S6	IELS provides accurate information	<i>NH 10.2.6 There is no difference between the means of accurate information from the perspective of the Education student groups</i>
S7	I am satisfied with IELTS operation	<i>NH 10.2.7 There is no difference between the means of IELTS operation from the perspective of the Education student groups</i>
S8	I am satisfied with IELTS speed	<i>NH 10.2.8 There is no difference between the means of IELTS speed from the perspective of the Education student groups</i>

Table 7-57 : Statements of Q10 and sub null hypotheses (Education groups)

7.2.2.6.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure satisfaction with the IELTS between the Education student groups (C1 and C2). Table 7.58 shows that the *p value* is lower than 0.05, which means satisfaction was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
S1	Dividing lectures into clips is better than delivering the whole lecture at once	(C1) Popup	8	0.037
		(C2) Click	8	0.005
S2	Video clips' time duration was appropriate	(C1) Popup	8	0.005
		(C2) Click	8	0.005
S3	IELS style presents a lecture in a new format to me	(C1) Popup	8	0.037
		(C2) Click	8	0.005
S4	IELS style interface designs are familiar to me	(C1) Popup	8	0.005
		(C2) Click	8	0.005
S5	IELS style interface colours are familiar to me	(C1) Popup	8	0.037
		(C2) Click	8	0.005
S6	IELS style multimedia is familiar to me	(C1) Popup	8	0.005
		(C2) Click	8	0.005
S7	I am satisfied with IELTS operation	(C1) Popup	8	0.000

Item	Statement	Action	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
S8	I am satisfied with IELS speed	(C2) Click	8	0.000
		(C1) Popup	8	0.037
		(C2) Click	8	0.000

Table 7-58 : Test for normality of distribution for IELS satisfaction (Education groups)

7.2.2.6.2 Basic statistical analysis

Table 7.59 shows the overall result for the Education student groups in terms of their perceptions regarding satisfaction in using the IELS application was a mean of 3.97, which is close to *Good* for C1 group, while it was a mean of 3.03 for group C2, which is close to *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
S1	Dividing lectures into clips is better than delivering the whole lecture at once	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.00	0.535
S2	Video clips' time duration was appropriate	(C1)Popup	8	4.00	0.535
		(C2)Click	8	3.00	0.535
S3	IELS style presents a lecture in a new format to me	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.00	0.535
S4	IELS style interface designs are familiar to me	(C1)Popup	8	4.00	0.535
		(C2)Click	8	3.00	0.535
S5	IELS style interface colours are familiar to me	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.00	0.535
S6	IELS style multimedia is familiar to me	(C1)Popup	8	4.00	0.535
		(C2)Click	8	3.00	0.535
S7	I am satisfied with IELS operation	(C1)Popup	8	4.25	0.463
		(C2)Click	8	3.13	0.354
S8	I am satisfied with IELS speed	(C1)Popup	8	3.88	0.641
		(C2)Click	8	3.13	0.354
Average mean of Popup 3.97 Average mean of Click 3.03					

Table 7-59 : Means of satisfaction for student groups C1 and C2 (Education groups)

7.2.2.6.3 Mann-Whitney U test

Table 7.60 shows there is a significant difference between group C1 and group C2 in items S1, S3 and S5 with a mean rank for C1 of 11.19, and a mean rank for C2 is of 5.81. Items S2, S4 and S6 have the same values.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p value</i>)	Action	N	Mean Rank
S1	Dividing lectures into clips is better than	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Action	N	Mean Rank
	delivering the whole lecture at once						
S2	Video clips' time duration was appropriate	7.000	-2.873	0.004	(C1)Popup	8	11.63
					(C2)Click	8	5.38
S3	IELS style presents a lecture in a new format to me	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81
S4	IELS style interface designs are familiar to me	7.000	-2.873	0.004	(C1)Popup	8	11.63
					(C2)Click	8	5.38
S5	IELS style interface colours are familiar to me	10.500	-2.486	0.013	(C1)Popup	8	11.19
					(C2)Click	8	5.81
S6	IELS style multimedia is familiar to me	7.000	-2.873	0.004	(C1)Popup	8	11.63
					(C2)Click	8	5.38
S7	I am satisfied with IELS operation	3.000	-3.335	0.001	(C1)Popup	8	11.63
					(C2)Click	8	5.38
S8	I am satisfied with IELS speed	11.500	-2.450	0.014	(C1)Popup	8	11.06
					(C2)Click	8	5.94

Table 7-60 : Mann-Whitney U test for IELS satisfaction (Education groups)

Overall, Table 7.60 shows that there is a significant difference between the means of satisfaction of the Education groups which indicates rejection of the null hypotheses as presented in Table 7.61.

Sub null hypotheses	Test
NH10.2 There is no difference between the means of satisfaction when using the IELS from the perspective of the Education student groups	Reject
<i>NH 10.2.1 There is no difference between the means of dividing lectures into clips when using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.2 There is no difference between the means of video clips' time duration when using the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.3 There is no difference between the means of new format of the IELS from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.4 There is no difference between the means of familiarity with interface designs from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.5 There is no difference between the means of familiarity with interface colours from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.6 There is no difference between the means of familiarity with style multimedia from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.7 There is no difference between the means of IELS operation from the perspective of the Education student groups</i>	<i>Reject</i>
<i>NH 10.2.8 There is no difference between the means of IELS operation from the perspective of the Education student groups</i>	<i>Reject</i>

Table 7-61 : Sub null hypotheses test result (Education groups)

7.2.3 Analysis of IT and Education Student groups

7.2.3.1 IELTS accessibility analysis

(Does accessibility differ between the IT and Education student groups?) To examine and evaluate the accessibility of the IT and Education student groups to the IELTS, null hypothesis NH5.3 was rewritten into five sub null hypotheses as shown in Table 7.32.

NH5.3 There is no difference between the means of accessibility from the perspective of the IT and Education student groups		
Item	Statement	Sub null hypotheses
A1	It was easy to register with IELTS	<i>NH 5.3.1 There is no difference between the means of being easy to register with the IELTS from the perspective of the IT and Education student groups</i>
A2	It was easy to sign in with IELTS	<i>NH 5.3.2 There is no difference between the means of being easy to sign in with IELTS from the perspective of the IT and Education student groups</i>
A3	It was easy to sign out from IELTS	<i>NH 5.3.3 There is no difference between the means of being easy to sign out from the IELTS from the perspective of the IT and Education student groups</i>
A4	It was easy to run the IELTS	<i>NH 5.3.4 There is no difference between the means of being easy to run the IELTS from the perspective of the IT and Education student groups</i>
A5	It was easy to access the contents of IELTS	<i>NH 5.3.5 There is no difference between the means of ease of access to its content from the perspective of the IT and Education student groups</i>

Table 7-62 : Statements of Q5 and sub null hypotheses (IT and Education groups)

7.2.3.1.1 Basic statistical analysis

Table 7.63 shows the result for the IT and Education student groups regarding their perceptions of accessing the IELTS was a mean of 3.74, which is close to *Good* for IT, while it was a mean of 3.35 for Education, which is between *Good* and *Satisfactory*.

Item	Statement	Action	N	Mean	Std. Deviation
A1	It was easy to register with IELTS	IT	16	3.69	0.873
		Education	16	3.31	0.793
A2	It was easy to sign in to IELTS	IT	16	3.81	0.911
		Education	16	3.38	0.806
A3	It was easy to sign out from IELTS	IT	16	3.69	0.873
		Education	16	3.38	0.806
A4	It was easy to run IELTS	IT	16	3.69	0.873
		Education	16	3.31	0.793

Item	Statement	Action	N	Mean	Std. Deviation
A5	It was easy to access the content of IELTS	IT	16	3.81	0.911
		Education	16	3.38	0.806
Average mean of IT 3.74 Average mean of Education 3.35					

Table 7-63 : Means of accessibility for IT and Education student groups

According to the Shapiro-Wilk test conducted in Table 7.64 data is not normally distributed between the IT and Education student groups therefore the Mann-Whitney U test must be used.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Action	N	Mean Rank
A1	It was easy to register with IELTS	97.500	-1.230	0.219	IT	16	18.41
					Education	16	14.59
A2	It was easy to sign in to IELTS	93.500	-1.378	0.168	IT	16	18.66
					Education	16	14.34
A3	It was easy to sign out from IELTS	103.500	-.985	0.324	IT	16	18.03
					Education	16	14.97
A4	It was easy to run IELTS	97.500	-1.230	0.219	IT	16	18.41
					Education	16	14.59
A5	It was easy to access the content of IELTS	93.500	-1.378	0.168	IT	16	18.66
					Education	16	14.34

Table 7-64 : Mann-Whitney U test For IELTS accessibility (IT and Education Groups)

According to the results shown in Table 7.64 there is no significant difference between the IT and Education student groups in all items because all *p* values are greater than the significant level of 0.05 which means all null hypotheses fail to be rejected as shown in Table 7.65.

ub null hypotheses	Result
NH5.3 There is no difference between the means of accessibility of the IELTS from the perspective of the IT & Education student groups	Fail to Reject
<i>NH5.3.1 There is no difference between the means of being easy to register with the IELTS from the perspective of the IT & Education student groups</i>	<i>Fail to Reject</i>
<i>NH5.3.2 There is no difference between the means of being easy to sign in with the IELTS from the perspective of the IT & Education student groups</i>	<i>Fail to Reject</i>
<i>NH5.3.3 There is no difference between the means being of easy to sign out from IELTS from the perspective of the IT & Education student groups</i>	<i>Fail to Reject</i>
<i>NH5.3.4 There is no difference between the means of being easy to run the IELTS from the perspective of the IT & Education student groups</i>	<i>Fail to Reject</i>
<i>NH5.3.5 There is no difference between the means of ease of access to its content from the perspective of the IT & Education student groups</i>	<i>Fail to Reject</i>

Table 7-65 : Sub null hypotheses test result for IELTS accessibility (IT & Education groups)

7.2.3.2 IELTS usability analysis

To analyse and evaluate the IELTS usability between the IT and Education student groups Q6 (*Does usability differ between the IT student groups?* was translated to null hypothesis NH6.3. Null hypothesis NH6.3 was rewritten into seven sub null hypotheses according to the usability items as shown in Table 7.65

NH6.3 There is no difference between the means of usability of the IELTS from the perspective of the IT student groups		
Item	Statement	Sub null hypotheses
U1	It was easy to use the IELTS	<i>NH 6.3.1 There is no difference between the means for ease of using the IELTS from the perspective of the IT and Education student groups</i>
U2	It was easy to edit my personal settings in the IELTS	<i>NH 6.3.2 There is no difference between the means for ease of editing personal settings in the IELTS from the perspective of the IT and Education student groups</i>
U3	It was easy to view my modules using the IELTS	<i>NH 6.3.3 There is no difference between the means for ease of viewing modules using the IELTS from the perspective of the IT and Education student groups</i>
U4	It was easy to view my lectures using the IELTS	<i>NH 6.3.4 There is no difference between the means for ease of viewing lectures using the IELTS from the perspective of IT and Education student groups</i>
U5	It was easy to view my video clips using the IELTS	<i>NH 6.3.5 There is no difference between the means for ease of viewing video clips using the IELTS from the perspective of the IT and Education student groups</i>
U6	It was easy to view my credits using the IELTS	<i>NH 6.1.6 There is no difference between the means for ease of viewing credits using the IELTS from the perspective of the IT student groups</i>
U7	It was easy to navigate using the IELTS	<i>NH 6.1.7 There is no difference between the means for ease of navigating using the IELTS from the perspective of the IT student groups</i>

Table 7-66 : Statements of Q6 and sub null hypotheses (IT and Education groups)

7.2.3.2.1 Basic statistical analysis

Table 7.67 shows the result for the IT and Education student groups regarding their perceptions of using the IELTS was mean of 3.97, which is close to *Good* for IT group, and a mean of 3.36 for group Education, which is between *Good* and *Satisfactory*.

Item	Statement	Actions	N	Mean	Std. Deviation
U1	It was easy to use the IELTS	IT	16	3.69	0.793
		Education	16	3.38	0.806
U2	It was easy to edit my personal	IT	16	3.75	0.775

Item	Statement	Actions	N	Mean	Std. Deviation
	settings in the IELTS	Education	16	3.38	0.806
U3	It was easy to view my modules using the IELTS	IT	16	4.19	0.750
		Education	16	3.38	0.806
U4	It was easy to view my lectures using the IELTS	IT	16	4.00	0.816
		Education	16	3.31	0.793
U5	It was easy to view my video clips using the IELTS	IT	16	4.13	0.719
		Education	16	3.31	0.873
U6	It was easy to view my credits using the IELTS	IT	16	4.00	0.894
		Education	16	3.38	0.806
U7	It was easy to navigate using the IELTS	IT	16	4.06	0.772
		Education	16	3.38	0.806
Average mean of IT 3.97 Average mean of Education 3.36					

Table 7-67 : Means of IELTS usability of IT and Education Student groups)

According to the Shapiro-Wilk test for data usability there is a significant difference between the IT and Education student groups which means the data is not normally distributed; therefore the Mann-Whitney U test must be used.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Action	N	Mean Rank
U1	It was easy to use the IELTS	100.500	-1.116	0.264	IT	16	18.22
					Education	16	14.78
U2	It was easy to edit my personal settings in the IELTS	94.000	-1.385	0.166	IT	16	18.63
					Education	16	14.38
U3	It was easy to view my modules using the IELTS	62.500	-2.613	0.009	IT	16	20.59
					Education	16	12.41
U4	It was easy to view my lectures using the IELTS	73.500	-2.182	0.029	IT	16	19.91
					Education	16	13.09
U5	It was easy to view my video clips using the IELTS	64.500	-2.540	0.011	IT	16	20.47
					Education	16	12.53
U6	It was easy to view my credits using the IELTS	77.000	-2.031	0.042	IT	16	19.69
					Education	16	13.31
U7	It was easy to navigate using IELTS	72.500	-2.222	0.026	IT	16	19.97
					Education	16	13.03

Table 7-68 : Mann-Whitney U test for IELTS usability (IT and Education groups)

Table 7.68 shows that there are significant differences between the groups in items U3, U4, U5, and U6 which indicates that their null hypotheses are rejected. While there are no

significant differences between the groups in items U1 and U2 which indicates their null hypotheses fail to be rejected as shown in Table 7.69.

Sub null hypotheses	Result
NH6.3 There is no difference between the means of usability of the IELTS from the perspective of the IT and Education students groups	Reject
<i>NH6.3.1 There is no difference between the means for ease of using the IELTS from the perspective of the IT and Education students groups</i>	<i>Fail to Reject</i>
<i>NH6.3.2 There is no difference between the means for ease of editing personal settings in the IELTS from the perspective of the IT and Education students groups</i>	<i>Fail to Reject</i>
<i>NH6.3.3 There is no difference between the means for ease of viewing modules using the IELTS from the perspective of the IT and Education students groups</i>	<i>Reject</i>
<i>NH6.3.4 There is no difference between the means for ease of viewing lectures using the IELTS from the perspective of the IT and Education students groups</i>	<i>Reject</i>
<i>NH6.3.5 There is no difference between the means for ease of viewing video clips using the IELTS from the perspective of the IT and Education students groups</i>	<i>Reject</i>
<i>NH6.3.6 There is no difference between the means for ease of viewing credits using the IELTS from the perspective of the IT and Education students groups</i>	<i>Reject</i>
<i>NH6.3.7 There is no difference between the means for ease of navigating using the IELTS from the perspective of the IT and Education students groups</i>	<i>Reject</i>

Table 7-69 : Sub null hypotheses test result for IELTS usability (IT & Education groups)

7.2.3.3 IELTS learnability analysis

Does learnability differ between the IT and Education student groups? To examine and evaluate the learnability between the IT and Education student groups when using the IELTS application, null hypothesis NH7.3 was rewritten into five sub null hypotheses as shown in Table 7.70.

NH7.3 There is no difference between the means of learnability of the IELTS from the perspective of the IT and Education groups		
Item	Statement	Sub null hypotheses
L1	It was easy to learn from the IELTS	<i>NH 7.3.1 There is no difference between the means of ease of learning from the IELTS from the perspective of the IT and Education groups</i>
L2	IELS actions are easy to learn from	<i>NH 7.3.2 There is no difference between the means of ease of leaning from action (Click or Popup) from the perspective of the IT and Education groups</i>
L3	IELS offered learning to me at any time as wanted	<i>NH 7.3.3 There is no difference between the means of ease of learning at any time from the IELTS from the perspective of the IT and Education groups</i>
L4	IELS facilitated the learning process	<i>NH 7.3.4 There is no difference between the means of facilitating the learning process from the perspective of the IT and Education</i>

NH7.3 There is no difference between the means of learnability of the IELTS from the perspective of the IT and Education groups		
Item	Statement	Sub null hypotheses
		<i>groups</i>
L5	IELS offered me more learning than the e-lecture	<i>NH 7.3.5 There is no difference between the means of IELTS offering more learning from the IELTS from the perspective of IT and Education groups</i>

Table 7-70 : Statements of Q7 and null hypotheses (IT and Education groups)

7.2.3.3.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to test the learnability of the IELTS between the IT and Education student groups (B and C). Table 7.71 shows that the *p value* is lower than 0.05, which means learnability was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Group	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
L1	It was easy to learn from the IELTS	(B) IT	16	0.004
		(C) Education	16	0.001
L2	IELS actions are easy to learn from	(B) IT	16	0.030
		(C) Education	16	0.030
L3	IELS offered learning to me at any time as wanted	(B) IT	16	0.029
		(C) Education	16	0.001
L4	IELS facilitated the learning process	(B) IT	16	0.027
		(C) Education	16	0.017
L5	IELS offered me more learning than the e-lecture	(B) IT	16	0.003
		(C) Education	16	0.001

Table 7-71 : Normality distribution test for IELTS learnability (IT and Education)

7.2.3.3.2 Basic statistical analysis

Table 7.72 shows the overall result for both groups in terms of perception regarding learnability when using the IELTS application. The mean was 3.74, which is close to *Good* for the IT group, while it was 3.46 for the Education group, which is between *Good* and *Satisfactory*.

Item	Statement	Group	N	Mean	Std. Deviation
L1	It was easy to learn from the IELTS	IT	16	3.81	0.750
		Education	16	3.38	0.619
L2	IELS actions are easy to learn from	IT	16	3.56	0.814
		Education	16	3.56	0.814

Item	Statement	Group	N	Mean	Std. Deviation
L3	IELS offered learning to me for any time as wanted	IT	16	3.81	0.834
		Education	16	3.25	0.683
L4	IELS facilitates the learning process	IT	16	3.63	0.885
		Education	16	3.50	0.816
L5	IELS offered me more learning than the e-lecture	IT	16	3.88	0.806
		Education	16	3.63	0.619
Average mean of IT 3.74 Average means of Education 3.46					

Table 7-72 : Means of learnability of experimental groups (IT and Education groups)

7.2.3.3.3 Mann-Whitney U test

Table 7.73 shows there is no significant difference between the IT and Education groups in all items. For example, in item L1 the mean rank for the IT group is 18.84, while the mean rank for the Education group is 14.16. There is also no significant difference between the two groups in item L2 the mean rank for both groups is 16.50.

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Group	N	Mean Rank
L1	It was easy to learn from the IELS	90.500	-1.549	0.121	IT	16	18.84
					Education	16	14.16
L2	IELS actions are easy to learn from	128.000	0.000	1.000	IT	16	16.50
					Education	16	16.50
L3	IELS offered learning to me at any time as wanted	75.000	-2.160	0.289	IT	16	19.81
					Education	16	13.19
L4	IELS facilitated the learning process	113.000	-0.603	0.546	IT	16	17.44
					Education	16	15.56
L5	IELS offered me more learning than the e-lecture	107.000	-0.860	0.390	IT	16	17.81
					Education	16	15.19

Table 7-73 : Mann-Whitney U test for IELS learnability (IT and Education groups)

Overall, Table 7.73 shows that there is no significant difference between the means of learnability of the IT and Education groups which indicates failure to reject the null hypotheses as presented in Table 7.74.

Sub null hypotheses	Result
NH 7.3 There is no difference between the means of learnability of the IELS from the perspective of the IT and Education student groups	Fail to reject
<i>NH 7.3.1 There is no difference between the means of ease of learning from the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 7.3.2 There is no difference between the means of ease of learning from action (Click or Popup) from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 7.3.3 There is no difference between the means of learning at any time from</i>	<i>Fail to</i>

Sub null hypotheses	Result
<i>the IELS from the perspective of the IT and Education groups</i>	<i>reject</i>
<i>NH 7.3.4 There is no difference between the means of facilitating the learning process from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 7.3.5 There is no difference between the means of IELS offering more learning than the e-lecture from the perspective of IT the and Education groups</i>	<i>Fail to reject</i>

Table 7-74 : Sub null hypotheses test result for IELS learnability (IT and Education groups)

7.2.3.4 IELS interactivity analysis

Does interactivity with the IELS differ between the IT and Education student groups? To examine and evaluate the perception of interactivity of the IT and Education groups in using the IELS application, null hypothesis NH8.3 was rewritten into three sub null hypotheses as shown in Table 7.75.

NH8.3 There is no difference between the means of interactivity of the IELS from the perspective of the IT and Education groups		
Item	Statement	Null hypotheses
I1	IELS offered me more interactivity with lecture contents than the e-lecture	<i>NH8.3.1 There is no difference between the means of interactivity of the IELS from the perspective of the IT and Education groups</i>
I2	IELS actions enhanced my level of interactivity	<i>NH8.3.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the IT and Education groups</i>
I3	IELS fostered my ability to use technology in the learning process	<i>NH8.3.3 There is no difference between the means of fostering the ability of learning from the perspective of the IT and Education groups</i>

Table 7-75 : Statements of Q8 and null hypotheses (IT and Education groups)

7.2.3.4.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the interactivity of the IELS between the IT and Education student groups (B and C). Table 7.76 shows that the *p value* is lower than 0.05, which means interactivity was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Group	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
I1	IELS offered me more interactivity with lecture contents than the e-lecture	IT	16	0.028
		Education	16	0.013
I2	IELS actions enhanced my level of interactivity	IT	16	0.019
		Education	16	0.013

Item	Statement	Group	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
I3	IELS fostered my ability to use technology in the learning process	IT	16	0.027
		Education	16	0.013

Table 7-76 : Normality distribution test for IELS interactivity (IT and Education groups)

7.2.3.4.2 *Basic statistical analysis*

Table 7.77 shows the overall result for the IT and Education student groups regarding their perceptions of interactivity when using the IELS application was a mean of 3.75, which is close to *Good* for the IT group, and a mean of 3.44 for the Education group, which is between *Good* and *Satisfactory*.

Item	Statement	Group	N	Mean	Std. Deviation
I1	IELS offered me more interactivity with lecture contents than the e-lecture	IT	16	3.69	0.793
		Education	16	3.44	0.727
I2	IELS actions enhanced my level of interactivity	IT	16	3.94	0.854
		Education	16	3.44	0.727
I3	IELS fostered my ability to use technology in the learning process	IT	16	3.63	0.885
		Education	16	3.44	0.727
Average mean of IT group 3.75 Average mean of Education group 3.44					

Table 7-77 : Means of IELS interactivity of student groups (IT and Education groups)

7.2.3.4.3 *Mann-Whitney U test*

Table 7.78 shows there is no significant difference between the IT and Education groups in all items when the Mann-Whitney U test is used. For example, in item I1 the mean rank for the IT group is 18.03, while the mean rank for the Education group is 14.97.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p value</i>)	Group	N	Mean Rank
I1	IELS offered me more interactivity with lecture content more than the e-lecture	103.500	-1.002	0.316	IT	16	18.03
					Education	16	14.97
I2	IELS actions enhanced my level of interactivity	82.500	-1.836	0.066	IT	16	19.34
					Education	16	13.66
I3	IELS fostered my ability to use technology in the learning process	108.000	-0.812	0.417	IT	16	17.75
					Education	16	15.25

Table 7-78 : Mann-Whitney U test for IELS interactivity (IT and Education groups)

Overall Table 7.78 shows that there is no significant difference between the means of interactivity of the Education and IT groups which indicates failure to reject the null hypotheses as presented in Table 7.79.

Sub null hypotheses	Result
NH8.3 There is no difference between the means of interactivity of the IELTS from the perspective of the IT and Education groups	Fail to reject
<i>NH8.3.1 There is no difference between the means of interactivity of the IELTS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH8.3.2 There is no difference between the means of interactivity level of action (Click or Popup) from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH8.3.3 There is no difference between the means of fostering the ability of learning from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>

Table 7-79 : Sub null hypotheses test result for IELTS interactivity (IT and Education groups)

7.2.3.5 IELTS communication analysis

Does user communication of the IELTS differ between the IT and Education student groups?

To examine and evaluate the communication between the IT and Education student groups when using the IELTS application, null hypothesis NH9.3 was rewritten into four sub null hypotheses as shown in Table 7.80.

NH9.3 There is no difference between the means of communication via the IELTS from the perspective of the IT and Education groups		
Item	Statement	Null hypotheses
C1	It was easy to communicate with my lecturer using the IELTS	<i>NH 9.3.1 There is no difference between the means of ease of communication with the lecturer via the IELTS from the perspective of the IT and Education groups</i>
C2	It was easy to get feedback from my lecturer using the IELTS	<i>NH 9.3.2 There is no difference between the means of getting easy feedback via the IELTS from the perspective of the IT and Education groups</i>
C3	It was easy to send messages to any user via IELTS	<i>NH 9.3.3 There is no difference between the means of being easy to send messages via the IELTS from the perspective of the IT and Education groups</i>
C4	It was easy to chat with any user via IELTS	<i>NH 9.3.4 There is no difference between the means of being easy to chat via the IELTS from the perspective of the IT and Education groups</i>

Table 7-80 : Statements of Q9 and null hypotheses (IT and Education groups)

7.2.3.5.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure the perceptions of communication of the IELTS between the IT and Education student groups (B and C). Table 7.79 shows that the *p value* is lower than 0.05, which means communication

was not normally distributed for most items, therefore nonparametric tests must be conducted.

Item	Statement	Group	Shapiro-Wilk Test	
			df	<i>P</i> value Sig.
C1	It was easy to communicate with my lecturer using the IELTS	(B) IT	16	0.043
		(C)Education	16	0.001
C2	It was easy to get feedback from my lecturer using the IELTS	(B) IT	16	0.026
		(C)Education	16	0.030
C3	It was easy to send messages to any user via IELTS	(B) IT	16	0.044
		(C)Education	16	0.001
C4	It was easy to chat with any user via IELTS	(B) IT	16	0.043
		(C)Education	16	0.001

Table 7-81 : Normality of distribution test for IELTS communication (IT and Ed groups)

7.2.3.5.2 *Basic statistical analysis*

Table 7.82 shows the overall result for the Education and IT student groups in terms of their perceptions of communication when using the IELTS application was a mean of 3.76, which is close to *Good* for the IT group, and a mean of 3.49 for the Education group, which is between *Good* and *Satisfactory*.

Item	Statement	Group	N	Mean	Std. Deviation
C1	It was easy to communicate with my lecturer using the IELTS	IT	16	3.69	0.873
		Education	16	3.38	0.619
C2	It was easy to get feedback from my lecturer using the IELTS	IT	16	3.88	0.957
		Education	16	3.56	0.814
C3	It was easy to send messages to any user via IELTS	IT	16	3.75	0.856
		Education	16	3.38	0.619
C4	It was easy to chat with any user via IELTS	IT	16	3.69	0.873
		Education	16	3.63	0.719
Average mean of IT is 3.76 Average mean of Education is 3.49					

Table 7-82 : Means of communication of student groups (IT and Education groups)

7.2.3.5.3 *Mann-Whitney U test*

Table 7.83 shows there is no significant difference between the Education and IT groups in all items; for example in item C1 the mean rank for the IT group is 18.09, while the mean rank for the Education group is 14.91.

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Group	N	Mean Rank
C1	It was easy to communicate with my lecturer using the IELS	102.500	-1.043	0.297	IT	16	18.09
					Education	16	14.91
C2	It was easy to get feedback from my lecturer using the IELS	103.000	-0.995	0.320	IT	16	18.06
					Education	16	14.94
C3	It was easy to send messages to any user via IELS	95.000	-1.350	0.177	IT	16	18.56
					Education	16	14.44
C4	It was easy to chat with any user via IELS	121.000	-0.284	0.776	IT	16	16.94
					Education	16	16.06

Table 7-83 : Mann-Whitney U test for IELS communication (Education and IT groups)

Overall, Table 7.83 shows that there is no significant difference between the means of communication of the Education and IT groups which indicates failure to reject the null hypotheses as presented in Table 7.84.

Sub null hypotheses	Result
NH9.3 There is no difference between the means of communication via the IELS from the perspective of the IT and Education student groups	Fail to reject
<i>NH9.3.1 There is no difference between the means of ease of communication with lecturer via the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH9.3.2 There is no difference between the means of getting easy feedback via the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH9.3.3 There is no difference between the means of being easy to send messages via the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH9.3.4 There is no difference between the means of being easy to chat via the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>

Table 7-84 : Sub null hypotheses test result for IELS communication (IT and Education groups)

7.2.3.6 IELS Satisfaction Analysis

To examine and evaluate the satisfaction between the IT and Education student groups when using the IELS application, null hypothesis NH10.3 was rewritten into eight sub null hypotheses as shown in Table 7.85.

NH10.3 There is no difference between the means of satisfaction when using the IELS from the perspective of the IT and Education student groups		
Item	Statement	Sub null hypotheses
S1	Dividing lectures into clips is	<i>NH 10.3.1 There is no difference between the</i>

NH10.3 There is no difference between the means of satisfaction when using the IELS from the perspective of the IT and Education student groups		
Item	Statement	Sub null hypotheses
	better than delivering the whole lecture at once	<i>means of dividing lectures into clips when using the IELS from the perspective of the IT and Education groups</i>
S2	Clips' time duration was appropriate	<i>NH 10.3.2 There is no difference between the means of clips' time duration when using the IELS from the perspective of the IT and Education groups</i>
S3	IELS style presents a lecture in a new format to me	<i>NH 10.3.3 There is no difference between the means of new format of the IELS from the perspective of the IT and Education groups</i>
S4	IELS style interface designs are familiar to me	<i>NH 10.3.4 There is no difference between the means of familiarity with interface designs from the perspective of the IT and Education groups</i>
S5	IELS style interface colours are familiar to me	<i>NH 10.3.5 There is no difference between the means of familiarity with interface colours from the perspective of the IT and Education groups</i>
S6	IELS style multimedia is familiar to me	<i>NH 10.3.6 There is no difference between the means of familiarity with style multimedia from the perspective of the IT and Education groups</i>
S7	I am satisfied with IELS operation	<i>NH 10.3.7 There is no difference between the means of IELS operation from the perspective of the IT and Education groups</i>
S8	I am satisfied with IELS speed	<i>NH 10.8 There is no difference between the means of IELS speed from the perspective of the IT and Education groups</i>

Table 7-85 : Statements of Q10 and null hypotheses (IT and Education groups)

7.2.3.6.1 Normality distribution test

The Shapiro-Wilk test was used to determine normality of distribution to measure satisfaction with the IELS between the IT and Education student groups (B and C). Table 7.86 shows that the *p value* is lower than 0.05, which means the satisfaction was not normally distributed for all items, therefore nonparametric tests must be conducted.

Item	Statement	Group	Shapiro-Wilk Test	
			df	Sig. (<i>p value</i>)
S1	Dividing lectures into clips is better than delivering the whole lecture at once	IT	16	0.001
		Education	16	0.013
S2	Clips' time duration was appropriate	IT	16	0.001
		Education	16	0.016

S3	IELS style presents a lecture in a new format to me	IT	16	0.001
		Education	16	0.013
S4	IELS style interface designs are familiar to me	IT	16	0.002
		Education	16	0.016
S5	IELS style interface colours are familiar to me	IT	16	0.001
		Education	16	0.013
S6	IELS style multimedia is familiar to me	IT	16	0.001
		Education	16	0.016
S7	I am satisfied with IELS operation	IT	16	0.036
		Education	16	0.002
S8	I am satisfied with IELS speed	IT	16	0.029
		Education	16	0.000

Table 7-86 : Normality distribution test for IELS satisfaction (IT and Education groups)

7.2.3.6.2 *Basic statistical analysis*

Table 7.87 shows the overall result for the Education student groups in terms of their perception regarding satisfaction when using the IELS application was a mean of 3.49, which is between *Good and Satisfactory* for the IT group, and 3.51 for the Education group, which is also between *Good and Satisfactory*.

Item	Statement	Group	N	Mean	Std. Deviation
S1	Dividing lectures into clips is better than delivering the whole lecture at once	IT	16	3.38	0.619
		Education	16	3.44	0.727
S2	Clips' time duration was appropriate	IT	16	3.38	0.619
		Education	16	3.50	0.730
S3	IELS style presents a lecture in a new format to me	IT	16	3.38	0.619
		Education	16	3.44	0.727
S4	IELS style interface designs are familiar to me	IT	16	3.31	0.704
		Education	16	3.50	0.730
S5	IELS style interface colours are familiar to me	IT	16	3.38	0.719
		Education	16	3.44	0.727
S6	IELS style multimedia is familiar to me	IT	16	3.44	0.629
		Education	16	3.50	0.730
S7	I am satisfied with IELS operation	IT	16	3.88	0.885
		Education	16	3.69	0.704
S8	I am satisfied with IELS speed	IT	16	3.81	0.834
		Education	16	3.50	0.632
Average mean of 3.49			Average mean of 3.51		

Table 7-87 : Means of satisfaction of student groups (IT and Education groups)

7.2.3.6.3 Mann-Whitney U test

Table 7.88 shows there is no significant difference between the IT group and the Education group in all items. In items S1 and S3 as the mean rank for the IT group is 16.28, while the mean rank for the Education group is 16.72.

Item	Statement	Mann-Whitney U	Z	Sig. (p value)	Group	N	Mean Rank
S1	Dividing lectures into clips is better than delivering the whole lecture at once	124.500	-0.147	0.883	IT	16	16.28
					Education	16	16.72
S2	Video clips' time duration was appropriate	117.000	-0.460	0.646	IT	16	15.81
					Education	16	17.19
S3	IELS style presents lectures in a new format to me	124.500	-0.147	0.883	IT	16	16.28
					Education	16	16.72
S4	IELS style interface designs are familiar to me	113.000	-0.620	0.536	IT	16	15.56
					Education	16	17.44
S5	IELS style interface colours are familiar to me	127.000	-0.041	0.967	IT	16	16.16
					Education	16	16.56
S6	IELS multimedia style is familiar to me	124.000	-0.167	0.867	IT	16	16.25
					Education	16	16.75
S7	I am satisfied with IELS operation	108.500	-0.788	0.431	IT	16	17.72
					Education	16	15.28
S8	I am satisfied with IELS speed	95.500	-1.330	0.183	IT	16	18.53
					Education	16	14.47

Table 7-88 : Mann-Whitney U test for IELS satisfaction (IT and Education groups)

Overall, Table 7.88 shows that there is no significant difference between the means of satisfaction of the IT and Education groups, which indicates failure to reject the null hypotheses as presented in Table 7.89.

Sub null hypotheses	Test
NH10.3 There is no difference between the means of satisfaction when using the IELS from the perspective of the IT and Education student groups	Fail to reject
<i>NH 10.3.1 There is no difference between the means of dividing lectures into clips when using the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.2 There is no difference between the means of clips' time duration when using the IELS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>

Sub null hypotheses	Test
<i>NH 10.3.3 There is no difference between the means of new format of the IELTS from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.4 There is no difference between the means of familiarity with interface designs from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.5 There is no difference between the means of familiarity with interface colours from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.6 There is no difference between the means of familiarity with multimedia style from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.7 There is no difference between the means of IELTS operation from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>
<i>NH 10.3.8 There is no difference between the means of IELTS speed from the perspective of the IT and Education groups</i>	<i>Fail to reject</i>

Table 7-89 : Sub null hypotheses test result (IT and Education groups)

7.2.4 Analysis of the IT and Education Lecturer Groups

The second users of the IELTS application are lecturers; two groups of lecturers participated in this study, four of them from the IT department and the other four from Education. When they finished using the IELTS application, they were asked to answer questionnaire form MQ2 (as shown in Appendix C).

Table 7.90 shows the means of the lecturer groups for the accessibility, usability and interactivity dimensions. It indicates that the means range from 3.50 to 4.50 regarding the lecturers' perceptions of those dimensions, which is between *Good* and *Outstanding*, reflects their positive experience when using the IELTS. Table 7.90 also shows a high means overall for interactivity which reflects the lecturers' interaction with the IELTS and indicates that this system motivated the users and enhanced their interactivity.

Dimension	Statement	Group	N	Mean	Std. Deviation
Accessibility	It was easy to register with IELTS	IT	4	3.75	0.500
		Education	4	3.75	0.500
	It was easy to sign in to IELTS	IT	4	3.75	0.500
		Education	4	3.50	0.577
	It was easy to sign out from IELTS	IT	4	3.75	0.500
		Education	4	3.50	0.577
It was easy to run IELTS	IT	4	3.50	0.577	
	Education	4	3.75	0.500	

Dimension	Statement	Group	N	Mean	Std. Deviation
	IELS was easy to access its content	IT	4	3.75	0.500
		Education	4	3.50	0.577
Usability	It was easy to use IELS	IT	4	4.00	0.816
		Education	4	3.50	0.577
	It was easy to edit my personal settings in IELS	IT	4	4.00	0.816
		Education	4	3.50	0.577
	It was easy to set up my modules using IELS	IT	4	4.00	0.816
		Education	4	3.75	0.500
	It was easy to set up my lectures using the IELS	IT	4	4.00	0.816
		Education	4	3.75	0.500
	It was easy to view my students 'report using IELS	IT	4	3.75	0.957
		Education	4	3.50	0.577
It was easy to upload video clips using IELS	IT	4	4.00	0.816	
	Education	4	3.50	0.577	
It was easy to navigate using IELS	IT	4	4.00	0.816	
	Education	4	3.50	0.577	
Interactivity	IELS offered my students more interactivity with lecture contents than the traditional lecture	IT	4	4.50	0.577
		Education	4	4.25	0.500
	IELS actions enhanced the level of interactivity of my students	IT	4	4.25	0.957
		Education	4	4.25	0.500
IELS fostered my ability to use technology in learning	IT	4	4.25	0.500	
	Education	4	4.00	0.816	

Table 7-90 : Means of accessibility usability and interactivity

Table 7.91 shows the analysis of the lecturers' means for the learnability, communication and satisfaction dimensions. The overall means range from 3.50 to 4.25 and indicate that the lecturers' responses are between *Good* and *Outstanding*.

Dimension	Statement	Group	N	Mean	Std. Deviation
Learnability	It was easy for my students to learn from IELS	IT	4	4.00	0.816
		Education	4	3.75	0.500
	It was easy to learn using IELS actions	IT	4	4.00	0.816
		Education	4	3.75	0.500
	IELS offered learning to my students at any time they wanted	IT	4	4.00	0.816
		Education	4	3.75	0.500
	IELS facilitated the learning process for my students	IT	4	4.00	0.816
		Education	4	3.75	0.500
IELS offered my students more learning than the traditional lecture	IT	4	4.00	0.816	
	Education	4	3.75	0.500	
	It was easy to communicate with my students using IELS	IT	4	4.25	0.500
		Education	4	3.50	0.577
	It was easy to get feedback from my students using IELS	IT	4	4.25	0.500
		Education	4	3.75	0.500

Dimension	Statement	Group	N	Mean	Std. Deviation
Communication	It was easy to send messages to any user via IELS	IT	4	4.25	0.500
		Education	4	3.50	0.577
	It was easy to chat with any user via IELS	IT	4	4.25	0.500
		Education	4	3.75	0.500
Satisfaction	Dividing lectures into clips is better than delivering the whole lecture at once	IT	4	4.25	0.500
		Education	4	3.75	0.500
	Video clips' time duration was appropriate	IT	4	4.25	0.500
		Education	4	3.75	0.500
	IELS style presents a lecture in a new format to me	IT	4	3.75	0.500
		Education	4	3.75	0.500
	IELS style interface designs are familiar to me	IT	4	3.75	0.500
		Education	4	3.75	0.500
	IELS style interface colours are familiar to me	IT	4	3.75	0.500
		Education	4	3.50	0.577
	IELS style multimedia is familiar to me	IT	4	4.25	0.500
		Education	4	3.50	0.577
I am satisfied with IELS operation	IT	4	4.25	0.500	
	Education	4	3.75	0.500	
I am satisfied with IELS speed	IT	4	4.25	0.500	
	Education	4	3.75	0.500	

Table 7-91 : Means of learnability, communication and satisfaction

Table 7.92 shows the results of the Mann-Whitney U test that was conducted to check the significance level for accessibility, usability and interactivity between lecturer groups when using the IELS. It shows that all the *p values* (Sig. 2-tailed) are larger than the significance level of 0.05 which indicates that there is no significant difference between the lecturer groups.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p value</i>)	Group	N	Mean Rank
Accessibility	It was easy to register with IELS	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
	It was easy to sign in to IELS	6.000	-0.683	0.495	IT	4	5.00
					Education	4	4.00
	It was easy to sign out from IELS	6.000	-0.683	0.495	IT	4	5.00
					Education	4	4.00
	It was easy to run IELS	6.000	-0.683	0.495	IT	4	4.00
					Education	4	5.00
	IELS was easy to access its	6.000	-0.683	0.495	IT	4	5.00
					Education	4	5.00

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Group	N	Mean Rank
	content				Education	4	4.00
Usability	It was easy to use IELS	5.000	-0.949	0.343	IT	4	5.25
					Education	4	3.75
	It was easy to edit my personal settings in IELS	5.000	-0.949	0.343	IT	4	5.25
					Education	4	3.75
	It was easy to set up my modules using IELS	5.000	-0.949	0.343	IT	4	5.25
					Education	4	3.75
	It was easy to set up my lectures using IELS	6.500	-0.500	0.617	IT	4	4.88
					Education	4	4.13
It was easy to upload video clips using IELS	6.500	-0.500	0.617	IT	4	4.88	
				Education	4	4.13	
It was easy to view my students' reports using IELS	7.000	-0.316	0.752	IT	4	4.75	
				Education	4	4.25	
It was easy to navigate using IELS	5.000	-0.949	0.343	IT	4	5.25	
				Education	4	3.75	
Interactivity	IELS offered my students more interactivity with lecture contents than the traditional lecture	6.000	-0.683	0.495	IT	4	4.00
					Education	4	5.00
	IELS actions enhanced the level of interactivity of my students	7.500	-0.158	0.874	IT	4	4.63
					Education	4	4.38
IELS fostered my ability to use technology in learning	6.500	-0.500	0.617	IT	4	4.88	
				Education	4	4.13	

Table 7-92 : Mann-Whitney U test for accessibility, usability and interactivity

Table 7.93 shows the results of the Mann-Whitney U test that was conducted to check the significance level for the learnability, communication and satisfaction dimensions between the lecturer groups when using the IELS. It shows that all the *p* values are larger than the significance level of 0.05 which indicates that there is no significant difference between the lecturer groups.

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Group	N	Mean Rank
Learnability	It was easy for my students to learn from IELS	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
	It was easy to learn using IELS actions	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
IELS offered learning to my	8.000	0.000	1.000	IT	4	4.50	

Item	Statement	Mann-Whitney U	Z	Sig. (<i>p</i> value)	Group	N	Mean Rank
	students at any time they wanted				Education	4	4.50
	IELS facilitated the learning process for my students	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
	IELS offered my students more learning than the traditional lecture	8.000	0.000	1.000	IT	4	4.50
Education					4	4.50	
Communication	It was easy to communicate with my students using IELS	5.000	-0.935	0.350	IT	4	5.25
					Education	4	3.75
	It was easy to get feedback from my students using IELS	6.500	-0.500	0.617	IT	4	4.88
					Education	4	4.13
	It was easy to send message to any user via IELS	5.000	-0.935	0.350	IT	4	5.25
					Education	4	3.75
It was easy to chat with any user via IELS	6.500	-0.500	0.617	IT	4	4.88	
				Education	4	4.13	
Satisfaction	Dividing lectures into clips is better than delivering the whole lecture at once	6.500	-0.500	0.617	IT	4	4.88
					Education	4	4.13
	Video clips' time duration was appropriate	4.500	-1.323	0.186	IT	4	5.38
					Education	4	3.63
	IELS style presents lectures in a new format to me	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
	IELS style interface designs are familiar to me	8.000	0.000	1.000	IT	4	4.50
					Education	4	4.50
	IELS style interface colours are familiar to me	6.000	-0.683	0.495	IT	4	5.00
					Education	4	4.00
	IELS multimedia style is familiar to me	3.000	-1.667	0.096	IT	4	5.75
					Education	4	3.25
I am satisfied with IELS operation	4.500	-1.323	0.186	IT	4	5.38	
				Education	4	3.63	
I am satisfied with IELS speed	4.500	-1.323	0.186	IT	4	5.38	
				Education	4	3.63	

Table 7-93 : Mann-Whitney U test for learnability, communication and satisfaction

According to the results shown in Table 7.92 and Table 7.93 there are no significant differences between the IT and Education lecturer groups because all *p* values are larger than 0.05 which indicates failure to reject the null hypotheses as presented in Table 7.94.

Null hypotheses	Test
NH5.4 There is no difference between the means of accessibility when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>
NH6.4 There is no difference between the means of usability when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>
NH7.4 There is no difference between the means of interactivity when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>
NH8.4 There is no difference between the means of learnability when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>
NH9.4 There is no difference between the means of communication when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>
NH10.4 There is no difference between the means of satisfaction when using the IELS from the perspective of the IT and Education lecturer groups	<i>Fail to reject</i>

Table 7-94 : Null hypotheses test result for lecturer groups

7.3 Analysis of Learning Outcomes

To answer Q11 (*Do learning outcomes differ between the e-lecture groups and the IELS groups*) in this research, learning outcomes were tested twice: before and after delivering the two types of lecture to the IT and Education student groups. This analysis compares the e-lecture with the IELS and examines the learning outcomes and whether there are significant differences between the student groups.

7.3.1 Analysis of the Results of the IT Groups

To analyse the IT student groups' learning outcomes Q11 was translated into null hypothesis NH11.1 (*There is no difference between the means of learning outcomes of e-lecture IT student groups and IELS IT student groups*). Therefore, both IT student groups' knowledge was assessed by pre-test and their learning outcomes were tested by post-test.

7.3.1.1 Analysis of the pre-test between e-lecture and IELS

To analyse the means of the IT students' pre-test, Table 7.95 shows no big difference between the means of the two groups. The mean of IELS was 5.75 with an SD of 1.528 which is slightly higher than that of the e-lecture group which was 5.06 with an SD of 1.569.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre test	e-lecture	16	5.06	1.569	0.392
	IELS	16	5.75	1.528	0.382

Table 7-95 : Basic statistics for pre-test for IT student groups

To examine the significant differences between the two groups a t-test was conducted. Table 7.96 shows no significant difference between their learning outcomes in the pre-test which was at -1.256 and the significance level was at 0.219 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig. (<i>p value</i>)	Mean Difference
Pre test	Equal variances assumed	-1.256	30	0.219	-0.688
	Equal variances not assumed	-1.256	29.978	0.219	-0.688

Table 7-96 : Independent t test sample (pre-test IT student groups)

7.3.1.2 Analysis of post-test between e-lecture and IELTS

Both IT groups were given a post-test to check their learning outcomes and examine the efficiency of the lecture formats. Table 7.97 shows that the mean of the IELTS group was much higher than that of the e-lecture group, with a mean of 13.75 and an SD of 1.183 while the mean of the e-lecture group was 8.19 with an SD of 2.713.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Post test	e-lecture	16	8.19	2.713	0.678
	IELS	16	13.75	1.183	0.296

Table 7-97 : Basic statistics for post-test for IT student groups

To examine the significant difference between the two groups a t-test was conducted. Table 7.98 shows a significant difference between their learning outcomes in the post-test because the t-test was at -7.517 and the significance level was at 0.000 which is below the level of significance of 0.05. This indicates that the IELTS format had a greater positive effect on students' learning outcomes than the e- lecture format.

t-Test for Equality of Means					
		t	df	Sig. (<i>p value</i>)	Mean Difference
Post test	Equal variances assumed	-7.517	30	0.000	-5.563
	Equal variances not assumed	-7.517	20.506	0.000	-5.563

Table 7-98 : Independent t test sample (post-test IT student groups)

According to the results shown in Table 7.98, there is a significant difference in the means of learning outcomes between e-lecture and IELTS IT student groups because p value is 0.000 which is less than the significant level of 0.05 which indicates rejection of null hypothesis NH11.1 as shown in Table 7.99.

Null hypothesis	Test
NH11.1 There is no difference between the means of learning outcomes of e-lecture and IELTS for IT student groups	Reject

Table 7-99 : Null hypothesis NH11.1 test result

7.3.1.3 Comparison between pre-test and post-test for the IELTS group

The performance of the IT student group before the two types of lecture were delivered was compared with that after. Table 7.100 shows a mean of 7.63 with an SD of 1.784 for the IELTS group in the pre-test, and a mean of 13.75 with an SD of 1.183 for the post-test.

	Test	N	Mean	Std. Deviation	Std. Error Mean
IELS Group	Pre	16	7.63	1.784	0.446
	Post	16	13.75	1.183	0.296

Table 7-100 : Basic statistics of pre-test and post-test for the IELTS group

To test the significance level of the IT group before and after the IELTS format was delivered, a Paired Sample test was conducted. Table 7.101 shows a significant difference between the means of the same IT group before and after the lecture because the level of significance was at 0.000 which is below the level of significance of 0.05

t-Test for Equality of Means					
	Mean	Std. Deviation	t	df	Sig. (p value)
Pre-test - Post test	-6.125	2.156	-11.362	15	0.000

Table 7-101 : Paired sample test (IELS group)

7.3.2 Analysis of the Results of the Education Groups

To analyse the Education student groups' learning outcomes Q11 was translated into null hypothesis NH11.2 (*There is no difference between the means of learning outcomes of e-lecture Education student groups and IELTS IT student groups*). Both Education student groups' knowledge was assessed by pre-test and their learning outcomes were tested by post-test.

7.3.2.1 Analysis of the pre-test between the e-lecture and the IELTS

To analyse the means of the Education students' pre-test, Table 7.102 shows no difference between that of the two groups; the mean of the e-lecture group was 5.69 with an SD of 1.138 which was slightly higher than the e-lecture group which had a mean of 5.63 with an SD of 1.025.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre test	e-lecture	16	5.69	1.138	0.285
	IELS	16	5.63	1.025	0.256

Table 7-102 : Basic statistics for pre-test for e-lecture and IELTS groups

To examine the significant differences between the two groups a t-test was conducted. Table 7.103 shows that there is no significant difference between their learning outcomes in the pre-test as the t-test was at 0.163 and the significant level was at 0.871 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig. (<i>p value</i>)	Mean Difference
Pre test	Equal variances assumed	0.163	30	0.871	0.068
	Equal variances not assumed	0.163	29.674	0.871	0.068

Table 7-103 : Independent t-test sample (pre-test)

7.3.2.2 Analysis of post-test for e-lecture and IELTS

Both the IT groups were given a post-test to check their learning outcomes and examine the efficiency of the lecture formats. Table 7.104 shows that the mean of the IELTS group was

much higher than that of the e-lecture group, with a mean of 12.75 and an SD of 1.342 for the IELTS group and a mean of 9.88 with an SD of 1.668 for the e-lecture group.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Post test	e-lecture	16	9.88	1.668	0.417
	IELS	16	12.75	1.342	0.335

Table 7-104 : Basic statistics for post-test for IELTS groups

To examine the significant difference between the two groups a t-test was conducted. Table 7.105 shows that there is a significant difference between their learning outcomes in the post-test because the t-test was at -5.372 and the significance level was at 0.000 which is below the level of significance of 0.05. The post-test result shows that the IELTS lecture format had a more positive effect on students learning outcomes than the e-lecture format.

t-Test for Equality of Means					
		t	Df	Sig.(<i>p value</i>)	Mean Difference
Post test	Equal variances assumed	-5.372	30	0.000	-2.875
	Equal variances not assumed	-5.372	28.680	0.000	-2.875

Table 7-105 : Independent t-test sample (post-test) Education groups

According to the results shown in Table 7.105 there is a significant difference in the means of learning outcomes between the e-lecture and IELTS Education student groups as the *p* value is 0.000 which is less than the significant level of 0.05 which indicates the null hypothesis NH11.2 should be rejected as shown in Table 7.106.

Null hypothesis	Test
NH11.2 There is no difference between the means of learning outcomes of e-lecture and IELTS for Education student groups	Reject

Table 7-106 : Null hypothesis NH11.2 test result

7.3.2.3 Comparison between the pre-test and post-test for the IELTS group

The performances of the Education student IELTS group before and after delivery of the two types of lecture were compared. Table 7.107 shows that the result of the pre-test was at a

mean of 5.63 with an SD of 1.025 while the result for the post-test was at a mean of 12.75 with an SD of 1.342.

	Test	N	Mean	Std. Deviation	Std. Error Mean
IELS Group	Pre	16	5.63	1.025	0.256
	Post	16	12.75	1.342	0.335

Table 7-107 : Basic statistics of pre-test and post-test for the IELS group

To test the significance level between the results of the Education group before and after the IELS lecture was delivered, a paired sample test was conducted. Table 7.108 shows that there is a significant difference between the means of the Education groups because the level of significance was at 0.000 which is below the level of significance of 0.05

t-Test for Equality of Means					
	Mean	Std. Deviation	t	df	Sig. (<i>p value</i>)
Pre-test - Post test	-7.125	1.628	-17.507	15	0.000

Table 7-108 : Paired sample test (IELS group)

7.4 Analysis of Exchange of Information between the IELS Groups

The IELS offers a rich communication environment that allows users to connect with each other. This enhances communication between students and also between students and their lecturers. For example, students may send emails via mail box to each other or to their lecturer. In addition, the IELS offers a chat area as another form of communication between its users. To analyse the two forms of communication, quantitative analysis was conducted. Time was taken into consideration in this analysis.

7.4.1 Analysis of Exchange of Information between IT Student Groups

The real time for the IT e-lecture was 50 minutes. After recording and converting the e-lecture format into short video clips according to the lecture topics, and taking out all pauses in the e-lecture, the duration of the IELS clip was about 39 minutes. This means there was

eleven minutes left after the clips which could encourage the IT students to communicate with each other and discuss or enquire about any topic relevant to the lecture contents. According to the time left after the video clips, which was eleven minutes for the IT lecture, the numbers of mail messages and chat messages sent will be analysed.

7.4.1.1 Analysis of sent messages

To analyse the sent messages between IT students or to their lecturer, the number of messages was divided by the number of minutes left. Table 7.109 shows the messages per minute sent from the IT student groups.

ID	Action Group	Minutes	Sent mail	Mail per Min
1	Popup	11	4	0.36
2	Popup	11	3	0.27
3	Popup	11	2	0.18
4	Popup	11	3	0.27
5	Popup	11	2	0.18
6	Popup	11	4	0.36
7	Popup	11	3	0.27
8	Popup	11	4	0.36
9	Click	11	2	0.18
10	Click	11	3	0.27
11	Click	11	2	0.18
12	Click	11	3	0.27
13	Click	11	3	0.27
14	Click	11	4	0.36
15	Click	11	3	0.27
16	Click	11	3	0.27

Table 7-109 : Sent mail per minute

To analyse the mean of sent messages from students between the IT groups (Popup and Click) basic statistics were conducted. Table 7.110 shows that the higher mean for the Popup group was 3.13 while it was 2.88 for the Click group.

	Action	N	Mean	Std. Deviation
IT Group	Popup	8	3.13	0.835
	Click	8	2.88	0.641

Table 7-110 : Means of messages for the IT groups

To analyse the significant difference of sent messages between the IT groups, independent t-tests were conducted. Table 7.111 shows there was no significant difference between the groups because the level of significance was 0.513 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig.(p value)	Mean Difference
Sent Message	Equal variances assumed	0.672	14	0.513	0.250
	Equal variances not assumed	0.672	13.126	0.513	0.250

Table 7-111 : Independent t-test sample messages for IT groups

7.4.1.2 Analysis of sent chat

To analyse the sent chat from IT students to each other or to their lecturer, the number of chats was divided by the number of minutes left. Table 7.112 shows chats per minute sent from the IT students groups.

ID	Action Group	Minutes	Sent chat	Chat per Min
1	Popup	11	3	0.27
2	Popup	11	5	0.45
3	Popup	11	3	0.27
4	Popup	11	4	0.36
5	Popup	11	7	0.64
6	Popup	11	4	0.36
7	Popup	11	3	0.27
8	Popup	11	4	0.36
9	Click	11	4	0.36
10	Click	11	5	0.45
11	Click	11	4	0.36
12	Click	11	7	0.64
13	Click	11	3	0.27
14	Click	11	4	0.36
15	Click	11	2	0.18
16	Click	11	1	0.09

Table 7-112 : Chats sent per minute (IT)

To analyse the mean of sent messages from students between the IT groups (Popup and Click) basic statistic was conducted. Table 7.113 shows that the higher mean for the Click group was 4.13 while it was 3.75 for the Popup group.

	Action	N	Mean	Std. Deviation
IT Group	Popup	8	4.13	1.356
	Click	8	3.75	1.832

Table 7-113 : Means of chat for IT groups

To analyse the significant difference of sent chat between the IT group an independent t-test was conducted. Table 7.114 shows there was no significant difference between groups because the level of significance was 0.649 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig.(p value)	Mean Difference
Sent chat	Equal variances assumed	0.465	14	0.649	0.375
	Equal variances not assumed	0.465	12.899	0.649	0.375

Table 7-114 : Independent t-test sample (sent chat per min) IT groups

According to the results shown in Table 7.111 and 7.114 there is no significant difference in the means of exchange of information between the IT student groups who used the IELTS because the p values are 0.513 for sent message and 0.649 for sent chat which is higher than the significance level of 0.05 which indicates failure to reject the null hypothesis NH12.1 as shown in Table 7.115.

Null hypothesis	Test
NH12.1 There is no difference between the means of exchange of information of the IELTS for IT student groups	Fail to reject

Table 7-115 : Null hypothesis NH12.1 test result

7.4.1.3 Analysis of exchange of information between e-lecture and the IELTS student groups

To compare between the means of IT students who were taught by e-lecture and the IELTS exchange of information and questions were asked during the e-lecture and the IELTS. All information and questions were combined to find the means for each group. Table 7.116 shows that the higher mean was at 6.94 for the IELTS student groups.

	Group	N	Mean	Std. Deviation
IT Students	IELS	16	6.94	1.611
	E-lecture	16	0.56	0.727

Table 7-116 : Means of student exchange of information for IT groups

According to the results shown in Table 7.117 there is a significant difference in the means of exchange of information between the IT students who attended the e-lecture and those who attended the IELTS.

T-Test for Equality of Means					
		t	Df	Sig.(<i>p value</i>)	Mean Difference
Exchange of information	Equal variances assumed	14.425	30	0.000	6.375
	Equal variances not assumed	14.425	20.872	0.000	6.375

Table 7-117 : Independent t-test sample (exchange of information) for IT groups

According to the independent t-test shown in Table 7.117 the *p* value is 0.000 which is less than the significance level of 0.05 which indicates rejection of null hypothesis NH12.2 as shown in Table 7.118.

Null hypothesis	Test
NH12.2 There is no difference between the means of exchange of information of the e-lecture and the IELTS for the IT student groups	Reject

Table 7-118 : Null hypothesis NH12.2 test result

7.4.2 Analysis of Exchange of Information between Education Student Groups

The real time for the Education e-lecture was 50 minutes. After recording and converting the e-lecture format into short video clips according to the lecture topics, and taking out all pauses in the e-lecture, the duration of the IELTS clip duration was about 42 minutes. This means there were eight minutes left after the clips which could encourage the Education students to communicate with each other and discuss or enquire about any topic relevant to the lecture contents. According to the time left after the video clips, the numbers of mail messages and chat messages sent will be analysed.

7.4.2.1 Analysis of sent messages

To analyse the sent messages between students or to their lecturer, the number of messages was divided by the number of minutes left. Table 7.119 shows the messages per minute sent from the Education student groups.

ID	Action Group	Minutes	Sent mail	Mail per Min
1	Popup	8	2	0.25
2	Popup	8	3	0.38
3	Popup	8	0	0.00
4	Popup	8	1	0.13
5	Popup	8	3	0.38
6	Popup	8	2	0.25
7	Popup	8	3	0.38
8	Popup	8	4	0.50
9	Click	8	1	0.13
10	Click	8	0	0.00
11	Click	8	2	0.25
12	Click	8	1	0.13
13	Click	8	3	0.38
14	Click	8	2	0.25
15	Click	8	3	0.38
16	Click	8	0	0.00

Table 7-119 : Sent mail per minute

To analyse the mean of sent messages from students between the IELTS Education groups (Popup and Click) basic statistic was conducted. Table 7.120 shows that the higher mean for the Popup group was 2.25 while it was 1.50 for the Click group.

	Action	N	Mean	Std. Deviation
Education Group	Popup	8	2.25	1.282
	Click	8	1.50	1.195

Table 7-120 : Mean of messages Education groups

To analyse the significant difference of sent messages between the IELTS Education groups, independent t-tests were conducted. Table 7.121 shows there was no significant difference between the groups because the level of significance was 0.246 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig.(<i>p value</i>)	Mean Difference
Sent Message	Equal variances assumed	1.210	14	0.246	0.750
	Equal variances not assumed	1.210	13.932	0.246	0.750

Table 7-121 : Independent t-test sample of sent messages for Education groups

7.4.2.2 Analysis of sent chat

To analyse the sent chat from students to each other or to their lecturer, the number of chats was divided by the number of minutes left. Table 7.122 shows chats per minute sent from the Education student groups.

ID	Action Group	Minutes	Sent chat	Chat per Min
1	Popup	8	5	0.63
2	Popup	8	4	0.50
3	Popup	8	6	0.75
4	Popup	8	3	0.38
5	Popup	8	5	0.63
6	Popup	8	2	0.25

ID	Action Group	Minutes	Sent chat	Chat per Min
1	Popup	8	5	0.63
7	Popup	8	2	0.25
8	Popup	8	1	0.13
9	Click	8	4	0.50
10	Click	8	3	0.38
11	Click	8	5	0.63
12	Click	8	4	0.50
13	Click	8	4	0.50
14	Click	8	6	0.75
15	Click	8	3	0.38
16	Click	8	4	0.50

Table 7-122 : Chats sent per minute

To analyse the mean of sent messages from students between the IELTS Education groups (Popup and Click) basic statistic was conducted. Table 7.123 shows that the higher mean for the Click group was 4.13 while it was 3.50 for the Popup group.

	Action	N	Mean	Std. Deviation
Education Group	Popup	8	3.50	1.773
	Click	8	4.13	0.991

Table 7-123 : Means of chat for Education groups

To analyse the significant difference of sent chat between the IELTS Education student groups an independent t-test was conducted. Table 7.124 shows there was no significant difference between groups because the level of significance was 0.399 which is higher than the level of significance of 0.05.

t-Test for Equality of Means					
		t	df	Sig.(p value)	Mean Difference
Sent chat	Equal variances assumed	-0.870	14	0.399	-0.625
	Equal variances not assumed	-0.870	10.986	0.403	-0.625

Table 7-124 : Independent t-test sample sent chat education groups

According to the results shown in Table 7.121 and 7.124 there is no significant difference in the means of exchange of information between the Education student groups who used the IELTS as p values are 0.246 for sent message and 0.399 for sent chat, which is higher than the

significance level of 0.05 which indicates failure to reject the null hypothesis NH12.3 as shown in Table 7.125.

Null hypothesis	Test
NH12.3 There is no difference between the means of exchange of information between the IELTS Education student groups	Fail to reject

Table 7-125 : Null hypothesis NH12.3 test result

7.4.2.3 Analysis of exchange of information between the e-lecture and the IELTS for Education student groups

To compare the means of IT students who learnt by e-lecture and the IELTS, exchange of information or questions were asked during the e-lecture and the IELTS. All information and questions were combined to find the means for each group. Table 7.126 shows that the IELTS has a higher mean than the e-lecture at 5.69.

	Group	N	Mean	Std. Deviation
Education Students	E-lecture	16	0.75	0.931
	IELS	16	5.69	1.537

Table 7-126 : Means of students' exchange of information for Education groups

According to the results shown in Table 7.127 there is a significant difference in the means of exchange of information between the IT students who attended the e-lecture and those who attended the IELTS.

t-Test for Equality of Means					
		t	df	Sig.(p value)	Mean Difference
Exchange information	Equal variances assumed	-10.991	30	0.000	-4.938
	Equal variances not assumed	-10.991	24.700	0.000	-4.938

Table 7-127 : Independent t-test sample (exchange of information) for Education groups

According to the independent t-test shown in Table 7.127 the p value is 0.000 which is less than the significant level of 0.05 which indicates rejection of the null hypothesis NH12.4 as shown in Table 7.128.

Null hypothesis	Test
NH12.4 There is no difference between the means of exchange of information between the e-lecture and the IELS for the Education student groups	Reject

Table 7-128 : Null hypothesis NH12.4 test result

7.5 Analysis of Students' Interaction with Lecture Content

To analyse students' interaction with lecture content a comparison was made between the student groups who attended the e-lecture and those who used the IELS. Each question, answer and comment in the e-lecture is considered as an interaction with the lecture content, whereas each action during the video clips is considered as an interaction with lecture content in the IELS. In terms of the student groups who worked on the IELS there were five video clips for the IT lecture and four for the Education lecture. Each video clip had many actions which might be Popup or Click depending on the type of group. These actions directed students to the content of the lecture and motivated them to focus on its content.

7.5.1 Analysis of IT Student Groups' Interaction

To analyse the variances between the IT groups who used the e-lecture and those who used the IELS the number of actions was considered as an interaction with the lecture content. Therefore 15 actions were set up in the IT IELS lecture and 16 students interacted with them. Table 7.129 shows that the IELS groups have the higher mean at 15.00 with an SD of 0.000.

	Group	N	Mean	Std. Deviation
IT students interaction	IELS	16	15.00	0.000
	E-lecture	16	.56	0.512

Table 7-129 : Means of IT student groups' interaction

According to the results shown in Table 7.130 there is a significant difference in the means of student interaction with lecture content between the IT students who attended the e-lecture and those who attended the IELS.

T-Test for Equality of Means					
		t	df	Sig. (<i>p value</i>)	Mean Difference
IT students interaction	Equal variances assumed	112.716	30	0.000	14.438
	Equal variances not assumed	112.716	15.000	0.000	14.438

Table 7-130 : Independent t-test sample (students interaction) IT groups

According to the independent t-test shown in Table 7.130, the p value is 0.000 which is less than the significant level of 0.05 which indicates rejection of the null hypothesis NH13.1 as shown in Table 7.131.

Null hypothesis	Test
NH13.1 There is no difference between the means of student interaction with lecture content between the e-lecture and the IELTS for the IT student groups	Reject

Table 7-131 : Null hypothesis NH13.1 test result

7.5.2 Analysis of Education Student Groups' Interaction

To analyse the variances between the Education groups who attend the e-lecture and those who used the IELTS, the number of actions is considered as an interaction with the lecture content. Seventeen actions were set up in the Education IELTS lecture and 16 students interacted with them. Table 7.132 shows that the IELTS groups have the higher mean at 17.00 with an SD of .000.

	Group	N	Mean	Std. Deviation
Education students' interaction	IELS	16	17.00	0.000
	E-lecture	16	0.75	0.477

Table 7-132 : Means of Education student groups' interaction

According to the results shown in Table 7.133 there is a significant difference in the means of student interaction with lecture content between the Education students who attended the e-lecture and those who attended the IELTS.

t-Test for Equality of Means					
		t	df	Sig.(p value)	Mean Difference
Education students interaction	Equal variances assumed	145.344	30	0.000	16.250
	Equal variances not assumed	145.344	15.000	0.000	16.250

Table 7-133 : Independent t-test sample (students interaction) Education groups

According to the independent t-test shown in Table 7.133 p value is 0.000 which is less than the significant level of 0.05 which indicates rejection of the null hypothesis NH13.2 as shown in Table 7.134.

Null hypothesis	Test
NH13.2 There is no difference between the means of student interaction with lecture content between the e-lecture and the IELTS for the Education student groups	Reject

Table 7-134 : Null hypothesis NH13.2 test result

7.6 Qualitative Analysis

At the end of questionnaires MQ1 and MQ2 participants were asked to answer the open question which reflects their feedback when they used the IELTS.

7.6.1 Analysis of Students' Responses

In questionnaire form (MQ1) 32 students from the IT and Education Departments were asked to submit their feedback after using the IELTS. As shown in Table 7.135 a total of 28 students submitted their opinions IELTS while four failed to submit any further comments.

ID	Department	Comment
1	IT	The idea of the IELTS is good and is worth applying
2	IT	The electronic lecture system is a good idea and its development should

ID	Department	Comment
		be encouraged in the future
3	IT	IELS provides motivation via interaction between the user and its content
4	IT	The interactive electronic lecture systems enhance self-learning via a new format
5	IT	It was very good experience to work on an interactive electronic lecture system
6	IT	I enjoyed working on the interactive electronic lecture system
7	IT	IELS made me interact with the lecture content
8	IT	No comments
8	IT	I like an interactive application such as IELS
10	IT	The system converted the e-lecture into an interactive electronic lecture
11	IT	I think the IELS supported the learning process
12	IT	IELS has good features but in my opinion the system's colour and interfaces need more development
13	IT	It was easy to use, access, navigate and communicate when using the IELS application
14	IT	I enjoyed working on the IELS
15	IT	IELS was a very useful system that supported the interactive lecture
16	IT	It was easy to communicate and obtain feedback from my colleagues and lecturer
17	Education	IELS make me concentrate and focus more on the lecture content
18	Education	No comments
19	Education	This system could be developed into an application
20	Education	It is a suitable application for online e-learning
21	Education	It was easy to see the lecture clips and interact with them
22	Education	IELS offers learning and communication at the same time
23	Education	From my point of view the IELS needs further development by adding some multimedia such as live video
24	Education	It was easy to register, access, learn, navigate, and communicate, therefore I was very satisfied
25	Education	System design was OK but I was not happy with some of the interface colours because the main screen is dark blue
26	Education	IELS simplified learning and presented the lecture content in a new format for me and facilitated communication
27	Education	No comments
28	Education	I am happy to run such an application and like working on interactive apps
29	Education	I enjoyed sending chat and messages to my colleagues
30	Education	The IELS is good but some sounds need to be added and some motivation such as games

ID	Department	Comment
31	Education	No comments
32	Education	In my opinion the IELS supported learning and communication process between students and their lecturer

Table 7-135 : Students' open question responses

7.6.2 Analysis of Lecturers' Responses

Eight lecturers participated in this experiment, half from the IT Department and the other half from the Education Department. They were asked to submit their opinions on their use of the IELS and all of them responded to the open question in MQ2. Table 7.136 shows the lecturers' responses in more detail.

ID	Department	Comment
1	IT	IELS allows continuous communication between students and their lecturer through mailbox or chat messages synchronously or asynchronously. It also helps students to absorb the information and concepts from a new learning format. The system also helped me in the process of assessing students and discovering their ability to acquire new skills. I hope the contents of this application will be developed and applied more widely.
2	IT	IELS worked properly with no errors, but there were some problems with internet connection which was very slow; therefore I suggest taking the video format into consideration when uploading the lecture video clips.
3	IT	It was a good experience to work on IELS. My students enjoyed working on it as well. It was easy to run, access and exchange messages. I suggest making more developments to this system to make the system applicable for any university and give the users the chance to customise their favourite colour and interfaces.
4	IT	It looks good but there are some comments that may help to develop this system in the future, such as adding some interactive techniques, for instance movable icons, personalising user page, changing colour, sending and uploading files.
5	Education	I worked on IELS. It was good a system. It presented the lecture in interactive electronic format and made the learning process easy so students could learn independently. In addition, it provided some means of communication between users, and the system also motivated students when they saw their credit
6	Education	In my opinion the system is okay, because it provides some reports for lecturers and shows students' progress in each lecture. This system

ID	Department	Comment
		offers learning for absent students or those who are not able to attend a lecture. I suggest making this system a mobile app which may work for undergraduate students.
7	Education	The system provided more room for communication between students and the lecturer and the exchange of different viewpoints in an atmosphere of freedom. It also enabled the students to identify their level of development of information, which motivated them to focus more. This system also provided learning content for students at any time they wanted. The use of the system was easy and uncomplicated so it helped in the learning process.
8	Education	The IELTS presents the lecture in a new format which enhances the interactivity and learnability in an interesting way. Also it supports communication between its users. I was happy to use this system; it was easy to access, use, communicate, and learn from. The one thing that was boring for me that was that it took time to set up clips and allocate action on the video clips.

Table 7-136 : Lecturers' open question responses

7.6.3 Discussion

Regarding the IT students' responses, most of them described the IELTS as a good and worthwhile application. They emphasised that the IELTS supported the level of interactivity between them and the lecture contents. They also highlighted the system's design, stating that it presented the lecture in a new format. They mentioned that this system enhanced the learning process. Most of them also expressed their satisfaction in using this system.

The Education students group also submitted their comments regarding their use of the IELTS. Their feedback did not differ from that of the IT group. They indicated that the system was easy to run, use, communicate and learn from. Some of them provided suggestions for developing the system in the future, such as adding sound, live video, and games. Some also commented on the system interfaces and colour. Table 7.135 shows the students' responses in more detail.

All the lecturers who participated in this experiment submitted their feedback and comments regarding their use of the IELTS. They were all happy with the system. They highlighted its interactivity and how students engaged in its activities, as well as the communication and learning process. They stated that the system could support communication by giving students the freedom to express their opinions. Some feedback and comments suggested

ways to develop the system in the future. They mentioned the size of video format and upload that is suitable for internet connection. In addition they mentioned that more flexible features could be developed for the system, such as interfaces, so that users could customise their personal pages or colours. Table 7.136 shows the lecturers' responses in more detail.

7.7 Conclusion

To conclude, this chapter has analysed many instruments that were conducted in the experiment. Two questionnaire forms, MQ1 and MQ2, were analysed, as were pre-tests and post-tests, and mail box and chat messages. Six main dimensions were taken into consideration during this analysis: IELS accessibility, usability, interactivity, learnability, satisfaction, and communication, according to the user's type and department. Comparison between the e-lecture and the IELS has been conducted throughout the analysis of students learning outcomes, exchange information and students interaction with the lecture content. Overall, the results reflected a positive experience from both types of user: students and lecturers. In addition it reflected the effectiveness and the efficiency of the IELS as a lecturing system that could support the learning and communication process at King Abdulaziz University.

8

Discussion and Evaluation

8.1 Introduction

This chapter evaluates and discusses the research results that were presented in Chapter 4 and Chapter 7. The significant research findings and implications will be discussed, the research questions answered and the null hypotheses test result will be shown. The six IELS dimensions (variables) will be addressed and evaluated by means of factor analysis, and the Spearman Correlation test used in order to check the relationship between all variables. In addition, this study will be checked against the four studies reviewed in Chapter 2. The IELS implementation will also be evaluated here in order to illustrate whether or not the creation and development of the Interactive Electronic Lecture System (IELS) is worthwhile and reliable and able to enhance and support the student learning outcomes compared to the e-lecture. In addition it will evaluate the students' engagement with the lecture content when they used the IELS against the e-lecture. Finally, it will show how this system could improve communication skills when information is exchanged between users more effectively than the e-lecture.

8.2 Preliminary Study

The preliminary study is a preparation for research. It enables the researcher to get a feel for the research topic. Therefore the aim of the preliminary study was to find out what further sources need to be used in the main study (Goddard and Melville, 2004).

Based on the quantitative results, this study showed that 65.5% of participants indicated that lectures were still delivered via the traditional method. Also, 82.65% of participants said that their college does not deliver lectures via its website. This indicates that the current situation of online lecturing is still in its infancy at King Abdulaziz University (KAU).

In addition, this study found that 72.7% of students preferred online lectures while 42.9% of lecturers think the e-lecture become an old method for lecturing. This could indicate that there is a serious demand for the creation of a new technology to deliver interactive online

lectures to support undergraduate students via university websites. More than 80% of participants were interested in using an interactive application as a new format for the lecture. This emphasises that there is a need to develop a new lecturing system which would create an interactive environment, and there is also a need to use technology, such as a new lecturing format, which could enhance the lecturing process at KAU.

With regards to the level of interactivity, the use of an interactive application for lecturing would enhance interactivity between students and the contents of lectures. It was found that 100% of students indicated that the interactive electronic lecture system would support communication between them and their lecturer and it could also affect their performance. From the lecturers' perspectives, the study revealed that 100% think that interactive electronic lectures have a positive effect on students' performance and experience.

In order to analyse the qualitative study, participants were given an open question about the idea of developing a new interactive electronic lecture system. Nine out of thirty three students submitted their answers to this question. All of them confirmed that the creation and development of a new system such as the IELS would have a positive effect on the learning and communication process. This predicts the answer to Q2 that the students at KAU would prefer to work with a new technology and receive their lectures electronically. In addition they desire the freedom to work wherever and whenever they want. They also mentioned that the interactive electronic lecture might create a competitive environment and provide a wide range of flexibility in lecturing.

All the participating lecturers answered the open question and submitted their opinions regarding the development of an interactive application for lectures. Most of them welcomed such an application and emphasised that it would enhance the learning process at KAU, and would shift the lecturing process to a new format that could present lecture content with new technology. These responses show that the development of an interactive application would improve communication between students and their lecturers and with each other. Their responses also show that such an interactive application would strengthen the relationship between students and the content of the lectures and make students focus on the material in the application.

In addition, their responses revealed that an online interactive application would create a free atmosphere for all users and allow them to learn wherever and whenever they wanted.

Finally, the preliminary study found there is the demand for the creation of an online interactive application to enhance the lecturing system at KAU.

No	Question	Answer
Q1	What is the current situation regarding delivering lectures at KAU?	65.5% of participants said e-lectures were delivered and 82.65% confirmed that their college does not deliver lectures electronically via its website
Q2	What is the desired situation for delivering lectures at KAU?	80% of participants are interested in using an interactive application
Q3	What learning theory could be applied within the interactive electronic lecture?	Both Connectivism and Constructivism
Q4	What technologies might be used to enhance interactivity in IELS?	Actions (Popup, Click)

Table 8-1 : Answers to questions 1 - 4

In conclusion, the preliminary study was conducted in order to determine the situation regarding the delivery of lectures at KAU, as well as to examine a number of issues related to the learning and communication process, and the type of lecture preferred by both students and lecturers. In order to achieve this aim, 33 students and 14 lecturers were randomly selected to participate in the study. Two forms of questionnaire were distributed online to obtain participants' opinions regarding this issue. The study found that it would be feasible to develop and establish an interactive electronic lecture application in order to support the learning and communication process at KAU. It also found that such an interactive application would improve the learning process and achieve greater communication between students and between students and lecturers. It would also bring a high level of interaction between students and the content of the lectures. In terms of the demographic element of this study, the majority of the participants were from the IT and Education departments, thus the researcher considered those groups for the main study.

8.3 Evaluation of the IELS

This section evaluates the IELS against the research questions and null hypotheses and is structured around the six dimensions of system design. In addition it evaluates and examines all variables within each dimension to find out whether these variables measured this dimension or not. Six main dimensions (variables) were considered in evaluating the impact

of applying the IELS, namely: accessibility, usability, interactivity, learnability, communication, and satisfaction. A comparison will be made between previous studies and the IELS to explore the differences between the two.

8.3.1 Accessibility

8.3.1.1 Previous studies vs IELS

In the study by Demetriadis and Pombortsis (2007) there was no evaluation of the accessibility dimension in the e-lecture, other than an indication that digital lectures increase learning flexibility as students can easily access online material and reuse it as needed. It may be relevant that students were only able to watch the e-lecture delivered in video format without any interactive involvement.

The focus of Jadin, Gruber and Batinic (2009), was on whether learning strategies brought about a change in learning outcomes. Their study found that the e-lecture format did not have a substantial impact on usage or learning outcome. However, the study did not measure the accessibility of the e-lecture.

Savoy and Salvendy (2009) measured whether the student could recall information presented via PowerPoint slides, verbally or visually. Their study did not evaluate accessibility at all. As with the previous studies, McMinn (2012) did not pay any attention at all to accessibility.

Accessibility of the IELS is an important aspect of this research. It was evaluated from the perspectives of both students and lecturers to determine the level of satisfaction reached by them. The result shows that the users found the IELS to be easy to access which indicates that this system achieved what users are looking for (see Chapter 7, Subsections 7.2.1.1, 7.2.2.1, 7.2.3.1, and 7.2.4).

8.3.1.2 Factor analysis

To evaluate whether the observed variables fitted and measured the dimension of accessibility factor analysis was conducted by Principal Component Analysis to explain the pattern of correlations within a set of observed variables. Table 8.2 shows that there is a strong relationship between all the variables which means that all variables measuring accessibility are highly correlated with this dimension. It means that all component matrix

values are between the range of 0.952 to 0.992 which is near to the initial value of 1.00 and reflects high correlation between items. It also shows how much of the variance in the variables has been accounted for by the extracted factors, as it shows the loadings of the five variables on the one component extracted.

	Communalities		Component Matrix
	Initial	Extraction	1
It was easy to register with IELTS	1.000	0.912	0.955
It was easy to sign in with IELTS	1.000	0.943	0.971
It was easy to sign out with IELTS	1.000	0.972	0.986
It was easy to run IELTS	1.000	0.983	0.992
It was easy to access the content of IELTS	1.000	0.907	0.952

Table 8-2 : Factor analysis result for accessibility

8.3.1.3 Overall accessibility result

As shown in Table 8.3, based on the results shown in Subsections 7.2.3.1 and 7.2.4 it was easy to access the IELTS from the perspectives of all users. It can be seen that all users' means are close to *Good*, except for the student education groups of the IELTS whose mean is between *Satisfactory* and *Good*. This is a clear indicator that the system is in an appropriate format that allows users to access it easily.

Accessibility to the IELTS	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
	IT(Student)			3.74		
	Ed(Student)			3.35		
	IT (Lecturer)			3.70		
	Ed(Lecturer)			3.60		

Table 8-3 : Overall accessibility result for the IELTS

8.3.2 Usability

8.3.2.1 Previous studies vs IELTS

No specific points regarding usability were evaluated by Demetriadis and Pombortsis (2007) other than a general mention that students feel motivated by the use of audio visual technology. Also, there is an indication that the use of e-lectures increases the flexibility of the learning experience.

Jadin, Gruber and Batinic (2009) discussed whether or not learners who use learning strategies have significantly better knowledge. No evaluation was found for the usability of

the e-lecture except the observation that it could be paused and replayed with familiar video control buttons (real media player) and navigated forward and backward with a timeline.

Savoy, Proctor and Salvendy (2009) mentioned that educational technology is most effective when used properly. In their study the e-lecture consisted of PowerPoint slides so no usability could be found from this kind of lecture because no actual engagement was required from students in that situation. They just watched and learned, therefore no measurement was conducted regarding usability.

McMinn (2012) did not include a usability test or evaluation. The main focus of his study was on acquisition of content knowledge when using the e-lecture.

The IELS study produced clear evidence of evaluation of usability from the perspective of users working with the IELS. Results show that users were happy when using the IELS which reflects their experience with this system. To ensure that the observed variables were measured, analysis of this dimension factor was conducted (see Chapter 7, Subsections 7.2.1.2, 7.2.2.2, 7.2.3.2, and 7.2.4).

8.3.2.2 Factor analysis

Eight variables represented the system's usability when data was collected from the questionnaire. These variables were evaluated by factor analysis to check their reliability regarding the usability of the IELS. According to Table 8.4 the result shows that each variable was close to the initial value and had a high correlation to assess this dimension. The Matrix Test emphasised that all variables represent one component. All extraction values were more than 0.6 which confirms that these variables were a suitable measurement tool to assess the usability dimension.

	Communalities		Component Matrix
	Initial	Extraction	1
It was easy to use IELS	1.000	0.786	0.887
It was easy to edit my personal settings in IELS	1.000	0.752	0.867
It was easy to view my modules using IELS	1.000	0.834	0.913
It was easy to view my lectures using IELS	1.000	0.891	0.944
It was easy to view my video clips using IELS	1.000	0.857	0.926
It was easy to view my credits using IELS	1.000	0.783	0.885
It was easy to navigate using IELS	1.000	0.787	0.887

Table 8-4 : Factor analysis result for usability of IELS

8.3.2.3 Overall result for usability

According to the results in Subsection 7.2.3.2 and 7.2.4 the overall result for the usability of the IELS was *Good* from the perspective of the IELS as a whole, except for the Education students group whose responses were between *Satisfactory* and *Good*, which reflects their expertise when they used the IELS as shown in Table 8.5.

	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
Usability of the IELS	IT (Student)				3.97	
	Ed (Student)			3.36		
	IT (Lecturer)				3.96	
	Ed (Lecturer)			3.57		

Table 8-5 : Overall usability result of the IELS

8.3.3 Interactivity

8.3.3.1 Previous studies vs IELS

Demetriadis and Pombortsis (2007) state that lecturer-student interaction should improve students' understanding in the live lecture while it should be compensated when using the e-lecture. However, the actual engagement from the students in this study occurred when they were able to see a lecture many times, but without any interaction between them and their colleagues and their lecturer. Also, this study indicated there was a lack of interaction between students when they used the e-lecture. Therefore, to compensate for the lack of interaction, students in e-lectures met the lecturer later in the classroom for a face-to-face discussion.

Jadin, Gruber and Batinic (2009) show that interactivity is an important factor when using e-lectures because students can adapt their individual needs. Interactivity in their study means navigating using control buttons to stop, pause, play and rewind the lecture.

Savoy, Proctor and Salvendy (2009) discuss the performance of students when they learn by lectures based on overhead projectors and e-lectures. No evaluation was made of the interactivity of students when using learning technology.

McMinn (2012) argues that the majority of students dislike the e-lecture because of the lack of interactivity between students and their lecturer and because there is no opportunity for social interaction and questioning. He also notes that students felt they were losing some of

the benefits of the lecture. In addition, he suggests a solution for this problem which would be to conduct a class discussion after the e-lecture.

The IELS produces a comprehensive solution that supports interactivity, not just between students, but also between students and their lecturer. This comes about via rich communication components that enable users to communicate whatever and whenever they want. The IELS grants students greater freedom than is offered in the e-lecture with regards to time and place. Using this system, students can ask questions, give feedback, share their opinions, discuss, and offer suggestions in a wide area of freedom without any stress or pressure (see Chapter 7, Subsections 7.2.1.3, 7.2.2.3, 7.2.3.3, and 7.2.4).

Interactivity actions were offered in the IELS and evaluated to examine the engagement of users and to check the level of interactivity between students and the content of the lecture. Popup and Click are motivated actions that cause students to focus on the lecture content and pay attention to specific topics. Based on this technology there is no need to compensate with a face to face class discussion because this system has already adapted this in its features.

8.3.3.2 Factor analysis

Table 8.6 shows that all values are more than 0.6. This is an indicator that the set of items correlated and measured the interactivity as an independent dimension. It also shows that all items were extracted under one component.

Communalities	Component Matrix		
	Initial	Extraction	
		1	
IELS offered me more interactivity with lecture content than the e-lecture	1.000	0.872	0.934
Popup/Click actions enhanced my level of interactivity	1.000	0.922	0.960
IELS fostered my ability to use technology in learning	1.000	0.905	0.951

Table 8-6 : Factor analysis result for interactivity

8.3.3.3 Overall interactivity result

Based on the result extracted in Chapter 7, Subsection 7.2.3.4 and 7.2.4 a comparison was made between the IELS users to determine whether there was a statistically significant difference between them. Table 8.7 provides the overall means for the IELS users produced for the statistical test. All the lecturers' responses were between *Good* and *Outstanding* while the IT students' responses were between *Satisfactory* and *Good*.

	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
Interactivity to the IELS	IT (Student)				3.75	
	Ed (Student)			3.44		
	IT (Lecturer)				4.33	
	Ed (Lecturer)				4.13	

Table 8-7 : Overall interactivity result for the IELS

8.3.4 Learnability

8.3.4.1 Previous studies vs IELS

Demetriadis and Pombortsis (2007) evaluate the flexibility of the learning experience by comparing the traditional lecture with the e-lecture. They show that the e-lecture increases the flexibility of the learning experience, and that viewing the e-lecture many times results in better learning. On the other hand, they show that there is no significant difference in the learning outcomes of the two groups.

Jadin, Gruber and Batinic (2009) conclude that the use of the e-lecture differs from one student to another. They also show that learning strategy is an important determinant of learning outcomes, and that the written transcript of the oral presentation has no effect on learning performance. In addition, they indicate that learning outcomes are significantly influenced by learner strategy and they make use of the interactive possibility of the video based e-lecture.

A study by Savoy, Proctor and Salvendy (2009) confirmed that students who attended lectures with PowerPoint slides performed better than those who did not. They argue that Education technology is most effective when it is used properly, it enhances the learning environment and fosters student performance. Hence lectures with PowerPoint slides are beneficial when students retain information.

McMinn (2012) found that students acquired a greater proportion of content knowledge and that their achievements increased when attending e-lectures rather than the traditional lecture. He also argues that the e-lecture would promote the students' success in unit examinations.

With regard to the IELS, its learnability was measured in terms of how using the IELS worked to support the learning process and to measure how it easy to learn from it. In addition, the system was evaluated by two types of user from different departments which indicated that it could be used by any user and for any topic. The perspectives of all users

were taken into consideration when evaluation was applied. All participants confirmed that it was easy to learn from the IELS, and reported that the system facilitated the learning process more than the e-lecture. They also confirmed that the system offered them more learning benefits than the e-lecture as they could learn whenever and wherever they wanted (see Chapter 7, Subsections 7.2.3.3 and 7.2.4).

8.3.4.2 Factor analysis

Five items represent the evaluation of the learnability of IELS. Table 8.8 shows that the extraction values of the five items were between 0.601 and 0.835 which is more than 0.6. Also the results show that all items represent and measure the component of learnability of the IELS.

	Communalities		Component Matrix
	Initial	Extraction	1
It was easy to learn from the IELS	1.000	0.835	0.914
IELS actions are easy to learn from	1.000	0.601	0.775
IELS offered learning to me at any time I wanted	1.000	0.686	0.765
IELS facilitated the learning process	1.000	0.803	0.896
IELS offered me more learning than the e-lecture	1.000	0.858	0.926

Table 8-8 : Factor analysis result for learnability

8.3.4.3 Overall learnability result

To discuss the overall result for IES learnability it is necessary to make a link with the IELS learning outcomes, because they support each other and give an indication as to how this system would enhance the learning process. Table 8.9 shows that all IELS users indicated between *Satisfactory* and *Good* with regard to the learnability of the system.

	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
Learnability of the IELS	IT(Student)				3.74	
	Ed(Student)			3.46		
	IT (Lecturer)				4.00	
	Ed(Lecturer)				3.75	

Table 8-9 : Overall learnability result for the IELS

8.3.5 Communication

8.3.5.1 Previous studies vs IELS

Demetriadis and Pombortsis (2007) emphasise the importance of teacher-student communication, highlighting the need for improvement in order to enable students to fully benefit from e-lectures. Jadin, Gruber and Batinic (2009) agree that there is no interaction with other students or the teacher to clarify any questions as well as lack of feedback, as a higher degree of intrinsic motivation and self-regulated learning are essential aspects of learning with e-lectures.

Jadin, Gruber and Batinic (2009) discuss and evaluate the issue of communication of the e-lecture. They agree with Demetriadis and Pombortsis (2007) that the e-lecture lacks the opportunity for feedback and communication between students and their lecturer and confirm that lack of lecturer-student communication is one of the disadvantages of an e-lecture.

Savoy, Proctor and Salvendy (2009) do not mention the communication issue, because the focus of their study is on information retention from the PowerPoint lecture compared to the traditional lecture.

McMinn (2012) reports that the communication issue is a huge challenge for delivery between students and their lecturer. He states that if a student has a question on the content of a lecture they cannot simply raise their hand as in the traditional lecture which remains a drawback of the technology of the e-lecture.

The IELS overcomes the problem faced in previous studies regarding communication between students and their lecturers. The IELS produces a rich environment of communication via message and chat boxes. It also creates an area of freedom which enables users to contact each other as individuals or as a group. In addition, the system helps them to share their ideas and obtain immediate feedback from their lecturer. It also protects the users' privacy when they need to communicate privately with each other (see Chapter 7, Subsections 7.2.3.5 and 7.2.4).

8.3.5.2 Factor analysis

Four items were addressed to check whether or not they evaluated communication. Table 8.10 shows that all extraction values were between 0.865 and 0.917 which indicates that they

correlated. It also shows that all items are under one component and measure the communication as one component.

Communalities	Initial		Component Matrix
	Initial	Extraction	
			1
It was easy to communicate with my lecturer using IELS	1.000	0.872	0.934
It was easy to get feedback from my lecturer using IELS	1.000	0.856	0.925
It was easy to send messages to any user via IELS	1.000	0.917	0.958
It was easy to chat with any user via IELS	1.000	0.867	0.931

Table 8-10 : Factor analysis result for communication

8.3.5.3 Overall communication result

Table 8.11 shows that the only group of users whose opinion was between *Good* and *Outstanding* was the IT lecturers, which could reflect their competence with computers and dealing with applications such as the IELS. The other groups were all between *Satisfactory* and *Good*.

	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
Communication to the IELS	IT (Student)			3.76		
	Ed (Student)			3.49		
	IT (Lecturer)				4.25	
	Ed(Lecturer)			3.63		

Table 8-11 : Overall communication result for the IELS

8.3.6 Satisfaction

8.3.6.1 Previous studies vs IELS

Demetriadis and Pombortsis (2007) found that students were satisfied with the whole experience and welcomed the e-lecture. They also found that the e-lecture can be safely used as introductory learning material to increase the flexibility of the learning process. In addition, they highlighted that this kind of e-lecture needs improvement and a learning design that could enable students to fully benefit from an e-lecture.

Jadin, Gruber and Batinic (2009) found that the e-lecture is helpful in enhancing the usage of cognitive metacognitive strategies and offers many flexible learning possibilities, but there is

a shortage of research on the design. In their study no results were found regarding the evaluation of users' attitudes toward the e-lecture.

Savoy, Proctor and Salvendy (2009) showed that students preferred to use PowerPoint presentation over the traditional lecture. They found that the course materials should influence the user of educational technology to develop a learning environment which fosters increased student attitude.

McMinn (2012) found that 69% of students in their study preferred the e-lecture over the traditional lecture. They also stated that the e-lecture is a tool that promotes students' interest in technology and enables them to work to acquire the knowledge contained in it.

Users' satisfaction in using the IELS was evaluated from various aspects. Two types of user, students and lecturers, participated in the evaluation, unlike the previous studies which focused only on the students' perspective. Most previous studies concentrated on general satisfaction while this study evaluates satisfaction in more detail, addressing eight items in the main questionnaire as shown in Table 8.12 and seen in Chapter 7, Subsections 7.2.3.6 and 7.2.4.

8.3.6.2 Factor analysis

The primary purpose of factor analysis is data reduction. Eight items were addressed to help to evaluate the satisfaction of the IELS. Table 8.13 shows that all extraction values were greater than 0.6, which indicates that they are near to the initial value which is 1.000, and they have high correlation when measuring the satisfaction of IELS. It also shows that those items were combined under one component.

Communalities	Initial		Component Matrix
	Initial	Extraction	1
Dividing lectures into clips is better than delivering the whole lecture at once	1.000	0.915	0.956
Video clips duration was appropriate	1.000	0.892	0.944
IELS presents a lecture in a new format to me	1.000	0.915	0.956
IELS interfaces design are familiar to me	1.000	0.826	0.909
IELS interfaces colour are familiar to me	1.000	0.871	0.933
IELS multimedia style is familiar to me	1.000	0.883	0.940
I am satisfied with IELS operation	1.000	0.690	0.768
I am satisfied with IELS speed	1.000	0.635	0.797

Table 8-12 : Factor analysis result for satisfaction

8.3.6.3 Overall satisfaction result

In order to evaluate satisfaction, participants were asked to give their opinion of the IELS, taking into consideration its features, such as: Dividing lectures into clips; Duration of clips; Interface design; Interface colour; and IELS multimedia. They were also asked if they enjoyed using the system. All their responses were between *Satisfactory* and *Good* except the IT lecturer group whose answers were between *Good* and *Outstanding* as shown in Table 8.13. This result reflects the satisfaction of all users and confirms their acceptance of the IELS and emphasises the need to create and develop interactive applications, such as the IELS, which support the learning and communication processes in lecturing. In general, users were positive when they submitted their responses with regard to their satisfaction in using the IELS.

	Type of User	Unsatisfactory	Poor	Satisfactory	Good	Outstanding
		1	2	3	4	5
Satisfaction to the IELS	IT(Student)			3.49		
	Ed(Student)			3.51		
	IT (Lecturer)				4.1	
	Ed(Lecturer)			3.69		

Table 8-13 : Overall satisfaction result of the IELS

8.3.7 Learning outcomes

This result of IELS learnability was confirmed by the result of the post-test when the students' learning outcomes were tested; it clearly revealed that the IELS student group's learning outcomes improved more than those of the e-lecture group, as shown in Table 8.14. It also shows that there was a significant difference between the groups, because students in the experimental groups achieved, in total, a mean score of 13.75 out of 15 which is higher than those in the e-lecture group who achieved a mean of 8.19 out of 15 for the IT student groups. Also the Education group who used the IELS achieved 12.75 out of 15 which is more than the e-lecture group who achieved 9.88.

Post-test	Type of User	Group	N	Mean
	IT Student	E-lecture	16	8.19
		IELS	16	13.75
	Education Student	E-lecture	16	9.88
IELS		16	12.75	

Table 8-14 : Overall post-test result of learning outcomes for all groups

8.3.8 Exchange information

System record is another point that could support communication when using the IELS. The IELS provides effective communication between the student groups and between students and their lecturer for exchanging information compared to the e-lecture, based on the results in Sections 7.4.1 and 7.4.2. Table 8.14 shows that there was a significant difference between the e-lecture and the IELS and indicates that students were able to stay in contact with each other or with their lecturers when they wished more with the IELS than when with the e-lecture.

Exchange Information	Type of User	Group	N	Mean
	IT Student	E-lecture	16	0.56
		IELS	16	6.94
	Education Student	E-lecture	16	0.75
IELS		16	5.69	

Table 8-15 : Overall test result of exchange information for all groups

8.3.9 Interaction with the lecture content

System record shows the level of students' interaction with their lecture content. This helps to measure their engagement with the IELS and provides further evidence of positive interactivity with the IELS. Table 8.16 shows that there was a significant difference between the e-lecture and the IELS student groups. This is an indication that the IELS lecture enhanced the level of students' engagement more than the e-lecture in keeping them more focussed on the lecture topic via the interactive IELS actions (Popup or Click).

Interaction with lecture content	Type of User	Group	N	Mean
	IT student	E-lecture	16	0.56
		IELS	16	15.00
	Education student	E-lecture	16	0.75
IELS		16	17.00	

Table 8-16 : Overall test result of interaction with lecture content

8.4 Null Hypotheses Testing

First of all, six main null hypotheses (NH5, NH6, NH7, NH8, NH9, and NH10) were presented in Chapter 3 (Section 3.3.4) to answer the research questions Q5 to Q10. These null hypotheses were analysed and tested based on the perspectives of participants in the main questionnaires MQ1 and MQ2 after using the IELS. The results of the tests of these hypotheses reflect the functionality of the IELS and state how effective and efficient it is to apply such a system. Based on the statistical tests conducted in Chapter 7 (sections 7.2.1, 7.2.2, 7.2.3 and 7.2.4) Table 8.17 was generated to show how the overall null hypotheses were tested. Firstly, it shows that there is no difference between the means of the IT student groups and no difference between them and the Education student groups. This indicates that they are statistically insignificant which means failure to reject the null hypothesis (✓) and is strong evidence that users found the IELS easy to access and reflects their positive experience. Secondly, Table 8.17 shows that there is a difference between the means of the Education groups (as subgroups who worked on Click and Popup Actions) regarding accessibility to the IELS. This shows that their means are statistically significant and the null hypothesis is rejected (✗). This is an indication that they may face problems accessing the IELS. It is possible there is a reason for this, such as a lack of computing skills or it could be related to their university level or lack of training. Thirdly, Table 8.17 shows an interesting result when testing null hypothesis NH6.3, that compares the usability of the IELS between the IT and Education student groups. This null hypothesis was divided into seven sub null hypotheses, two of which were not rejected (✓) and the other five were rejected (✗); therefore in combining these results it was indicated that the overall result regarding the main null hypothesis is partially rejected (✓✗).

No	Dimension	Null Hypotheses	Test Result
NH5.1	Accessibility	<i>There is no difference between the means of accessibility to the IELTS from the perspective of the IT student groups</i>	✓
NH5.2		<i>There is no difference between the means of accessibility to the IELTS from the perspective of the Education student groups</i>	✗
NH5.3		<i>There is no difference between the means of accessibility to the IELTS from the perspective of the IT and Education student groups</i>	✓
NH5.4		<i>There is no difference between the means of accessibility to the IELTS from the perspective of the IT and Education lecturer groups</i>	✓
NH6.1	Usability	<i>There is no difference between the means of usability of the IELTS from the perspective of the IT student groups</i>	✓
NH6.2		<i>There is no difference between the means of usability of the IELTS from the perspective of the Education student groups</i>	✗
NH6.3		<i>There is no difference between the means of usability of the IELTS from the perspective of the IT and Education student groups</i>	✗
NH6.4		<i>There is no difference between the means of usability of the IELTS from the perspective of the IT and Education lecturer groups</i>	✓
NH7.1	Interactivity	<i>There is no difference between the means of interactivity of the IELTS from the perspective of the IT student groups</i>	✓
NH7.2		<i>There is no difference between the means of interactivity of the IELTS from the perspective of the Education student groups</i>	✗
NH7.3		<i>There is no difference between the means of interactivity of the IELTS from the perspective of the IT and Education student groups</i>	✓
NH7.4		<i>There is no difference between the means of interactivity of the IELTS from the perspective of the IT and Education lecturer groups</i>	✓
NH8.1	Learnability	<i>There is no difference between the means of learnability of the IELTS from the perspective of the IT student groups</i>	✓
NH8.2		<i>There is no difference between the means of learnability of the IELTS from the perspective of the Education student groups</i>	✗
NH8.3		<i>There is no difference between the means of learnability of the IELTS from the perspective of the IT and Education student groups</i>	✓
NH8.4		<i>There is no difference between the means of learnability of the IELTS from the perspective of the IT and Education lecturer groups</i>	✓
NH9.1	Communication	<i>There is no difference between the means of communication of the IELTS from the perspective of the IT student groups</i>	✓
NH9.2		<i>There is no difference between the means of communication of the IELTS from the perspective of the Education student groups</i>	✗
NH9.3		<i>There is no difference between the means of communication of the IELTS from the perspective of the IT and Education student groups</i>	✓

No	Dimension	Null Hypotheses	Test Result
NH9.4		<i>There is no difference between the means of communication of the IELS from the perspective of the IT and Education lecturer groups</i>	✓
NH10.1	Satisfaction	<i>There is no difference between the means of satisfaction with the IELS from the perspective of the IT student groups</i>	✓
NH10.2		<i>There is no difference between the means of satisfaction with the IELS from the perspective of the Education student groups</i>	✓
NH10.3		<i>There is no difference between the means of satisfaction with the IELS from the perspective of the IT and Education student groups</i>	✓
NH10.4		<i>There is no difference between the means of satisfaction with the IELS from the perspective of the IT and Education lecturer groups</i>	✓

Table 8-17 : Main null hypotheses (NH5-NH10) test result

Table 8.17 shows that twenty four null hypotheses were tested to evaluate the six main dimensions. Five of the null hypotheses were rejected because there were significant differences between the users according to their experience in using the IELS. One null hypothesis was partially rejected, but eighteen failed to be rejected, which may indicate the efficiency and validity of the IELS as a lecturing system because no differences were found between the users when the six dimensions were tested.

Secondly, as a result of using the IELS and its effectiveness based on dependent variable three main topics were covered when evaluating the IELS: students learning outcomes, exchange of information and students interaction with the lecture content to answer questions Q11 to Q13. Eight sub null hypotheses extracted from the main null hypotheses (NH11 NH12 and NH13) were analysed and tested based on another instrument such as pre-test, post-test and system records. Table 8.18 shows the test results of null hypotheses comparing the mean of using e-lectures with the mean of using the IELS.

With regard to student learning outcomes, the results show that NH11.1 and NH11.2 were rejected which emphasises that there was significant difference between the mean of the student groups who were taught using the IELS and the student groups who were taught using the e-lecture. This reflects the substantial impact of the IELS on students' achievements and enhancing the learning process by producing successful results.

In comparing between the means of student groups who received the e-lecture and those who received the IELS, in terms of exchange of information the results show that the null

hypotheses (NH12.2 and NH12.4 were rejected because there is significant difference between the groups. This also reflects the IELS effectiveness in supporting the communication process in the exchange of information between users. This result is also substantiated when null hypotheses NH12.1 and NH12.3 failed to be rejected and this confirms that there was no significant difference between the IT student groups and between the Education student groups when they used the IELS to exchange information.

Finally Table 8.18 shows that the null hypotheses NH13.1 and NH13.2 were rejected when the students' interaction with the lecture content was compared between the e-lecture and the IELS. The results indicate that there is a significant difference in favour of the IELS that supports student engagement and creates an interactive environment which makes them active and focused on the lecture content.

No		Null Hypotheses	Result
NH11.1	Learning Outcomes	There is no difference between the means of learning outcomes of e-lecture and IELS for IT student groups	<i>x</i>
NH11.2		There is no difference between the means of learning outcomes of e-lecture and IELS for Education student groups	<i>x</i>
NH12.1	Exchange Information	There is no difference between the means of exchange of information between the IELS for IT student groups	✓
NH12.2		There is no difference between the means of exchange of information of e-lecture and IELS for IT student groups	<i>x</i>
NH12.3		There is no difference between the means of exchange of information between the IELS Education student groups	✓
NH12.4		There is no difference between the means of exchange of information between the e-lecture and the IELS for Education student groups	<i>x</i>
NH13.1	Interaction with lecture content	There is no difference between the means of student interaction with lecture content of e-lecture for IT student groups and IELS IT student groups	<i>x</i>
NH13.2		There is no difference between the means of student interaction with lecture content of e-lecture and IELS for Education student groups	<i>x</i>

Table 8-18: Main null hypotheses(NH11-NH13) test result

8.5 Answer to Research Questions (Q5-Q13)

According to the results of the tests on the null hypotheses, the research questions Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, and Q13 can be answered. The sub questions were addressed as shown in Table 8.19. In order to answer Q5 (*Does accessibility differ between the IELTS groups?*) the question was divided into three main sub-questions according to the groups of students who worked on the IELTS. These questions were formulated according to the null hypotheses and their answers were extracted from the null hypothesis test. Based on this test, Q5.1 and Q5.3 were answered as negative (**No**). This indicates that accessibility to the IELTS does not differ between the IT groups or between the IT groups and the Education student groups. This reflects the proper format of the IELTS as it was easy to access. On the other hand, an affirmative answer (**Yes**) was given to the research question Q5.2, because accessibility differs between the Education student groups who worked on different actions when accessing the IELTS. This means half of them found it easy to access but the other half did not (see Table 8.19 for more details).

No	Questions	Answer
Q5	Does accessibility differ between the IELTS groups?	
Q5.1	Does accessibility to the IELTS differ between the IT student groups?	No
Q5.2	Does accessibility to the IELTS differ between the Education student groups?	No
Q5.3	Does accessibility to the IELTS differ between the IT and Education student groups?	No
Q5.4	Does accessibility to the IELTS differ between the IT and Education lecturer groups?	No
Q6	Does usability differ between the IELTS groups?	
Q6.1	Does usability of the IELTS differ between the IT student groups?	No
Q6.2	Does usability of the IELTS differ between the Education student groups?	Yes
Q6.3	Does usability of the IELTS differ between the IT and Education student groups?	Yes /No
Q6.4	Does usability of the IELTS differ between the IT and Education lecturer groups?	No
Q7	Does interactivity differ between the IELTS groups?	
Q7.1	Does interactivity with the IELTS differ between the IT student groups?	No
Q7.2	Does interactivity with the IELTS differ between the Education student groups?	Yes
Q7.3	Does interactivity with the IELTS differ between the IT and Education student groups?	No
Q7.4	Does interactivity with the IELTS differ between the IT and Education lecturer groups?	No

No	Questions	Answer
Q8	Does learnability differ between the IELS groups?	
Q8.1	Does learnability of the IELS differ between the IT student groups?	No
Q8.2	Does learnability of the IELS differ between the Education student groups?	Yes
Q8.3	Does learnability of the IELS differ between the IT and Education student groups?	No
Q8.4	Does learnability of the IELS differ between the IT and Education lecturer groups?	No
Q9	Does communication differ between the IELS groups?	
Q9.1	Does users' communication when using the IELS differ between the IT student groups?	No
Q9.2	Does users' communication when using the IELS differ between the Education student groups?	Yes
Q9.3	Does users' communication when using the IELS differ between the IT and Education student groups?	No
Q9.4	Does users' communication when using the IELS differ between the IT and Education lecturer groups?	No
Q10	Does satisfaction differ between the IELS groups?	
Q10.1	Does satisfaction with the IELS differ between the IT student groups?	No
Q10.2	Does satisfaction with the IELS differ between the Education student groups?	No
Q10.3	Does satisfaction with the IELS differ between the IT and Education student groups?	No
Q11	Do learning outcomes differ between the e-lecture and IELS student groups?	Yes
Q11.1	Do learning outcomes differ between the e-lecture and IELS for IT student groups?	Yes
Q11.2	Do learning outcomes differ between the e-lecture and IELS for Education student groups?	Yes
Q12.1	Does exchange of information differ between the IELS IT student groups?	NO
Q12.2	Does exchange of information differ between the e-lecture and IELS for IT student groups?	Yes
Q12.3	Does exchange of information differ between the IELS Education student groups?	NO
Q12.4	Does exchange of information differ between the e-lecture and IELS for Education student groups?	Yes
Q13	Does interaction with lecture content differ between the e-lecture groups and the IELS groups?	Yes
Q13.1	Does interaction with lecture content differ between the e-lecture and the IELS for IT student groups?	Yes
Q13.1	Does interaction with lecture content differ between the e-lecture and the IELS for Education student groups?	Yes

Table 8-19 : Research questions answers

8.6 Correlation between IELS Variables

To evaluate the strength of the relationship between the IELS variables, the Spearman Correlation Coefficient test was conducted in which $r=1$ refers to perfect positive correlation and $r=-1$ refers to perfect negative correlation. Table 8.17 illustrates the relationship between the variables; for example, according to this result there is a high correlation between accessibility and usability. This means there is a strong and positive correlation between the two variables (accessibility and usability) and indicates that it is statistically significant ($r = .855, p = 0.000$).

For further explanation, when comparing the relationship between learnability and satisfaction ($r=0.808, p=0.000$) this mean high learnability is required in using the system as well as high satisfaction. This also reflects the extent of the relationship between these variables.

As shown in Table 8.20, the Spearman Correlation Coefficient test provides complete evidence for the association between all variables as there is a strong relationship and high correlation between satisfaction and the other variables which reflects the possibility of applying the IELS as a lecturing system.

Spearman's rho		Accessibility	Usability	Interactivity	Learnability	Communication	Satisfaction
Accessibility	Correlation Coefficient	1.000	0.855**	0.815**	0.835**	0.848**	0.804**
	Sig. (<i>p value</i>)	.	0.000	0.000	0.000	0.000	0.000
	N	32	32	32	32	32	32
Usability	Correlation Coefficient	0.855**	1.000	0.849**	0.821**	0.760**	0.778**
	Sig. (<i>p value</i>)	0.000	.	0.000	.000	0.000	.000
	N	32	32	32	32	32	32
Interactivity	Correlation Coefficient	0.815**	0.849**	1.000	0.708**	0.692**	0.661**
	Sig. (<i>p value</i>)	0.000	0.000	.	0.000	0.000	0.000
	N	32	32	32	32	32	32
Learnability	Correlation Coefficient	0.835**	0.821**	0.708**	1.000	0.745**	0.808**
	Sig. (<i>p value</i>)	0.000	0.000	0.000	.	0.000	0.000
	N	32	32	32	32	32	32
Communication	Correlation Coefficient	0.848**	0.760**	0.692**	0.745**	1.000	0.886**
	Sig. (<i>p value</i>)	0.000	0.000	0.000	0.000	.	0.000

	N	32	32	32	32	32	32
Satisfaction	Correlation Coefficient	0.804**	0.778**	0.661**	0.808**	0.886**	1.000
	Sig. (<i>p value</i>)	0.000	0.000	0.000	0.000	0.000	.
	N	32	32	32	32	32	32

Table 8-20 : Correlation coefficient between variables

8.7 Evaluation of IELS Implementation

The aim of this study is to enhance the learning process at King Abdulaziz University. The purpose of the adoption of a new format of lecturing is to encourage KAU undergraduate students to use a new technique in lecturing instead of the e-lecture. The IELS represents an opportunity to improve lecturing. To build an e-learning environment, the interactive system has to take into consideration the learner's needs during the whole e-learning life cycle (Hadjerrouit, 2007). Also, the development of the e-learning system should consider the alignment of individual and organizational learning needs, as well as the integration of learning and communication between individuals (Ottenbreit-Leftwich *et al.*, 2012). Therefore the IELS was built according to users' needs and was designed to address issues such as accessibility, usability, interactivity, learnability, communication and satisfaction. The IELS offers a rich communication environment that allows users to contact each other. This enhances the communication between students as well as between students and lecturers.

Two types of evaluation were applied at this stage, formative evaluation and summative evaluation.

* *Formative evaluation* Formative evaluation refers to evaluating continuously during each phase of implementing the IELS and between different phases. It aims to improve learning design before presenting it as the final version of the IELS for application. Formative evaluation focuses on the development of the IELS. According to this evaluation the IELS as a system was subjected to some changes, such as the style of the application, colours, icons, navigation and so on; this came from some users' feedback or from an expert review.

* *Summative evaluation* Summative evaluation usually occurs after the implementation of the final version of the learning design. This type of evaluation assesses the overall effectiveness

of the learning design. In other words, it concentrates on whether or not the learning design has achieved the intended effects, rather than providing information about improving it (Hodges, 2011). In this phase the focus of evaluating the IELS was on seeing how the system itself presents the lecture content in a way which motivates and supports the learning process in a novel style. It also aimed to enhance the interactivity between the lecture content and students, and to enhance the communication between the students and their lecturers. The IELS evaluated the students' engagement with their lectures and provided an easy means of communication.

8.8 Comparison between IELS and Previous Studies

Four previous studies (Demetriadis and Pombortsis, 2007; Jadin, Gruber and Batinic, 2009; Savoy and Salvendy, 2009; and McMinn, 2012) have been published in the context of the e-lecture as stated in the literature review in Chapter 2 of this thesis. Those studies used different approaches to discuss certain dimensions and points regarding the e-lecture. A comparison will be conducted between those studies and the results of this research.

In the study by Demetriadis and Pombortsis (2007) the flexibility of learning was the main point in their research. The e-lecture was delivered to the students using three different types of technology and evaluated against the traditional lecture in a classroom as reviewed in Chapter 2 (section 2.6.6.1).

A similar study conducted by Jadin, Gruber and Batinic (2009) on the e-lecture took into consideration the meaning of learning strategies. In their study the e-lecture was delivered to the students in two formats: the first format was the video-based e-lecture with synchronised written transcript of oral presentation (multimodal presentation) while the second format was without synchronised written transcript (unimodal presentation).

The third study was conducted by Savoy, Proctor and Salvendy (2009). It was a comparison between the traditional lecture and the lecture via PowerPoint slides, to compare the effect on the retention of information.

The fourth study by McMinn (2012) investigated whether the instructional method of the e-lecture would have an impact on student performance. Two types of lecture format were used

in McMinn's study: the traditional lecture with PowerPoint slides and the e-lecture that indicates the audio was recorded over the PowerPoint slides.

In the IELS research the e-lecture was converted into a novel format in the form of the Interactive Electronic Lecture System (IELS). This research addresses some issues such as learning outcomes, exchange of information and interaction with the lecture content, and these issues were compared between the e-lecture and the IELS. This research has also discussed another six dimensions with regard to the effectiveness and performance of the IELS. Table 8.21 shows a comparison between the previous studies and the IELS.

Author name	Demetriadis & Pombortsis (2007)	Savoy & Salvendy (2009)	Jadin, Gruber & Batinic (2009)	McMinn (2012)	Althobaiti 2015
Study title	e-Lectures for Flexible Learning	Information Retention from PowerPoint and e-Lecture	Learning with E-Lectures	Lecturing for Success	Interactive Electronic Lecture System
Type of Application/software	PowerPoint slides	PowerPoint slides	Interactive video synchronisation with written text VS without text	E-lectures VS e-lecture	Web application Interactive video clips Click & Popup
Application platform	PowerPoint	PowerPoint	Real player Video control buttons	PowerPoint	Dreamweaver PHP
Lecture topic area	Computer sciences	Industrial Engineering and Psychology	Economics	History	IT & Education
Participants	Students n=72	Students n = 45	Students n=28	Students n=44	Preliminary study n= 47 (33students and 14 lecturers) Main study n=74 (64 students and 10 lecturers)
Methods and instruments	Questionnaires Pre-test Post-test	Questionnaires Quiz	Questionnaires Test	Pre-test & Post-test Survey	Preliminary questionnaires Main questionnaires Pre-test & Post-test System records
Main finding	The students may learn efficiently at the introductory	Students who attended either one of the lecture presentations (PowerPoint or	There is no significant connection between learning environment and	There is an increase in students' knowledge when e-lectures are	IELS has a positive effect on students' experience regarding all variables and there is a strong and positive relationship between all

Author name	Demetriadis & Pombortsis (2007)	Savoy & Salvendy (2009)	Jadin, Gruber & Batinic (2009)	McMinn (2012)	Althobaiti 2015
	level by using e-lecturing material and they are also satisfied with the flexibility of the experience	traditional performed better than those who did not attend	the chosen strategy	used compared to the traditional lecture	variables and satisfaction
Test learning outcomes	Pre-test and post-test	Information retention by quiz	Test	Pre-test and post-test	Yes Pre-test and post-test
Test system learnability	No	No	No	No	Yes Questionnaires
Test system accessibility	No	No	No	No	Yes
Test system usability	No	No	No	No	Yes
Test system interactivity	No	No	Yes	Yes	Yes
Test system communication	No	No	No	No	Yes
Test System satisfaction	No	No	No	No	Yes
Test exchange of information	No	No	No	No	Yes System records (message box, Chat area & Observation)
Test student interaction with lecture content	No	No	No	No	Yes System records & Observation

Table 8-21 : Comparison between the IELTS and previous studies

8.9 Conclusion

In this chapter the preliminary study and the main study were discussed and evaluated. The IELS dimensions (variables) were also addressed and evaluated. Four previous studies were compared with the IELS in each variable to check the similarities and differences between them. Each variable was tested and its overall result extracted. In order to determine the relationship or variances among each variable factor analysis was conducted. Then the main null hypotheses were tested to answers the research questions. To evaluate the strength of the relationship between all variables Spearman Correlation Coefficient was conducted. In addition, the implementation of the IELS was discussed and evaluated. Finally a comparison was made between the previous studies and the IELS.

The following chapter will conclude the research findings and results. It will also summarise the experiment, and research contributions, and then assess the criteria of success. Finally, it will highlight the research limitation and suggest future research.

9

Conclusion and Future Work

9.1 Introduction

This research has been conducted to examine the impact of an innovative new lecturing format, the interactive electronic lecture system (IELS), which has been created and developed, as well as to examine whether the IELS enhances interactivity between students and their lectures. The aim of creating this system was to evaluate its effectiveness on the communication and learning processes. Preliminary and main studies were conducted with volunteer undergraduate students and lecturers in order to examine the IELS. This chapter will summarise the experiment and conclude the research findings. It will also address the research contributions and judge the criteria for success. Finally it will highlight the research limitations and suggest future work.

9.2 Summary of Experiment

IELS is a web application that contains a number of elements developed together using the PHP language to form the Interactive Electronic Lecture System (IELS). The IELS consists of a number of main components, including lectures, video clips, and interactive interfaces. The IELS delivers lectures to undergraduate students in a novel format that creates an interactive environment to enable students to interact with the lecture content as well as to communicate with other system users, such as their lecturers and colleagues. In simple terms, the IELS is a lecturing application that has a flexible format for any academic subject in which lectures can be uploaded as short video clips and then certain interactive actions can be carried out which enable users to interact with the lecture content.

The IELS was created and developed to enhance the learning process at King Abdulaziz University (KAU), and to improve the communication process between students as well as between students and their lecturers. It is also intended to create an alternative solution to the e-lecture in a new format which adds some interactivity that may motivate students to work

more effectively. To carry out this research an experiment was conducted at KAU to examine the feasibility and the efficiency of this new system; two studies were conducted: the preliminary study and the main study.

A significant reason for applying the preliminary study (Chapter 4) was the need to determine the current situation of delivering lectures at the university, as well as to discover the features required to deliver successful lectures, and to identify what technologies could be developed and used to enhance the lecturing process at KAU. Mixed methods were applied in conducting the preliminary study, and two types of user were involved. Thirty-three undergraduate students and 14 lecturers participated to ascertain the technologies that might be used to support their interactivity and communication within the lecturing process. Two different questionnaires (Appendix B) were distributed to them to discover their attitudes with regard to developing the lecturing process.

Quantitative and qualitative methods were used to carry out the main study (Chapter 7). Two departments were chosen to participate, IT and Education, because the majority of participants in the preliminary study were from these two departments. Sixty-four students and 10 lecturers were involved. These were divided into two groups, with 32 students and two lecturers in the control group (A groups) who attended the e-lecture, and 32 students and eight lecturers in the experimental group (B and C groups) who used the IELS. All student groups were given pre-tests to examine their knowledge before the experiment was conducted. After the experiment their learning outcomes were tested by post-test to make a comparison between the two groups. Moreover some issues related to using the system, such as accessibility, usability, interactivity, learnability, communication and satisfaction were evaluated by questionnaire (Appendix C) to measure their attitudes to the system.

9.3 Summary of Research Findings

Firstly, to summarise the findings of the preliminary study (Chapter 4), it was found that the lecturing system at King Abdulaziz University still uses traditionally delivered e-lectures. This indicates a serious need to find an electronic way of delivering lectures which would support all types of student, such as distance students or those who are unable to attend the traditional class. The study also found that there is a need to use an interactive application which engages students with the lecture content. Moreover, it found that there is a lack of

communication when attending the e-lecture. It established that this kind of application creates a competitive environment and provides a wide range of flexibility of lecturing and has a positive effect on the learning process. Furthermore, all users hope to have their lectures electronically and work using technology with the freedom which supports all modules and subjects. The study discovered that it would be feasible to develop and establish an interactive electronic lectures application in order to support the learning and communication process at KAU. It also showed that such an interactive application would improve the learning process and achieve greater communication between students and between students and lecturers and would also offer a high level of interaction between students and the content of the lectures.

Secondly, the main study (Chapter 7) found that one of the purposes of the adoption of a new format of lecturing is to encourage KAU undergraduate students to use the new technique in lecturing instead of the e-lecture. Some issues were analysed and evaluated according to the research questions defined in Chapter 1, and the main study finding is summarised as follows:

1. According to the results of the evaluation of the accessibility of the IELS, all users found it easy to access with a high level of satisfaction regarding accessibility features such as registration, signing in, signing out, and running the system, which indicates that the IELS is easily accessible and has an easy and quick format.
2. The main study produced clear evidence that, in terms of the usability of the IELS, from the perspective of users they were satisfied with it because it was easy to use. This reflected their experience in using it as they indicated the system is not just useable but also reusable.
3. The IELS enhanced and supported the learning process so the students were able to achieve better learning outcomes when they used the IELS than those who attended e-lecture. This was confirmed by all users who indicated that in terms of learnability the IELS provides flexibility and facility in the learning process so students can learn whenever and wherever they want.
4. Results for interactivity showed that there was high engagement between the students and the lecture content and topic. Also, IELS actions Popup and Click

motivated students to focus on the lecture content and pay attention to specific topics as well to interact with the IELS.

5. No communication activities were recorded between students and their lecturer when attending the e-lecture; apart from a few questions being asked, students just listened. In contrast, the IELS provided effective communication between all users via rich components such as message box and chat area. The results showed that the IELS overcame the problem regarding communication that was faced in previous studies. It presented immediate feedback via the chat area and private feedback via message box, as students using the system asked questions, gave and received feedback, shared their opinions, discussed, and offered suggestions with a great deal of freedom, without pressure or constraints.
6. All users showed a good level of satisfaction using the IELS regarding many issues such as the lecture being divided into short clips, duration of clips, system interfaces, and colours. Overall they enjoyed using the system and indicated their satisfaction with a positive experience.

9.4 Research Contribution

The contribution and the originality of this research lie in the following points:

1. This research was applied in Saudi Arabia at King Abdulaziz University where an experiment was conducted to enhance e-learning via lecturing system which had never been used there.
2. There were two stages to the study, the preliminary study and the main study, to evaluate and assess the feasibility and creation of the interactive electronic lecture system (Chapter 4 and Chapter 7).
3. Two types of user were involved in evaluating this system, undergraduate students and lecturers.
4. Two departments, IT and Education, participated to evaluate the IELS from several perspectives.

5. This research presented the IELS as an innovative solution to enhance and support the lecturing process with a novel format, and offer a new environment for lecturing (Chapter 5).
6. Six main issues were taken into consideration when evaluating the IELS, namely: accessibility, usability, interactivity, learnability, communication and satisfaction (Chapter 8).
7. This research shifted the lecturing process from the e-lecture to the IELS that may achieve great success in the future (Chapter 5).
8. This research provided a useful guideline and approach to develop and design the interactive electronic lecture system built on learning design theory (Chapter 6).
9. This research adopted some learning theories such as constructivism and connectivism to make the system robust (Chapter 2 and Chapter 5).
10. This research solved some problems that had previously been faced, and filled the gap that was found in previous studies, such as the lack of communication between users (Chapter 8).
11. This research employed some technologies such as Popup Action and Click to improve the level of interactivity between the users and the system as well between the students and the lecture content (Chapter 5).
12. Based on the evaluation of the IELS this system facilitated the learning process and provided communication components as well creating an interactive environment between students and lecture content (Chapter 8).
13. The IELS motivated students by creating competition between them via the system's credit and score (Chapter 8).

9.5 Criteria for Success

Six factors were addressed in Chapter 1 (Section 1.3) to investigate the criteria for success. These factors will be judged to ensure this research was conducted successfully as follows:

1- Identify critical factor for creating and developing IELS

This research will conduct a preliminary study to explore certain issues, and investigate the feasibility of creating and developing a system such as the interactive electronic lecture system for undergraduate students at King Abdulaziz University. Thus, some research questions will be investigated and taken into consideration, such as;

- *Q1 What is the current situation regarding delivering lectures at KAU?*
- *Q2 What is the desired situation for delivering lectures at KAU?*

The creation and development of a new lecturing system was a critical factor in conducting this study, therefore two questions were identified and considered to check the feasibility of doing this research. In order to answer these two questions a preliminary study was conducted (Chapter 4), and mixed methods were used to deliver a questionnaire to participants. The questionnaire analysis showed that there was lack of interactive electronic systems in lecturing as well as a lack of online materials at KAU. However, participants were very keen to work with a new lecturing system that could offer greater success than the e-lecture. The preliminary study showed there was a significant reason to create and develop a new lecturing system such as the Interactive Electronic Lecture System. It also found a need to develop a system for lecturing that could enhance learning, communication and interaction. This system could be accessible and reusable whenever and wherever users want. In addition this study found that 100% of participants were happy to use a system such as the IELS (Section 4.3) and all of them confirmed that the creation and development of a system such as the IELS would have a positive effect on the learning and communication process.

2- Provide guidelines for designing and developing IELS

This research will provide guidelines to build an interactive electronic environment that will include certain types of multimedia, suitable for undergraduate students in higher education.

To prepare a comprehensive guideline that will help to build a new system, two questions will be answered.

- *Q3 What learning theory could be applied within the interactive electronic lecture?*
- *Q4 what technologies might be used to enhance interactivity in the IELS?*

This research provided a useful guideline for designing and developing a new lecturing system, and some learning theories and learning design were adopted to create a comprehensive system. According to constructivism learning theory, students construct their own knowledge and build their experience, and they communicate with each other in social activities as identified in connectivism theory (Chapter 2, Section 2.1.3).

Based on connectivism and constructivism theories, the interactive electronic lecture system (IELS) was developed as a combination of interactive interfaces and actions to allow students to be actively involved in the body of knowledge as well as to give them a free and wide learning environment to help them to build and own their knowledge and to have a positive experience (Chapter 5).

The Dick and Carey model (ADDIE) is a continuous circle learning design that was followed in this research to design the interactive electronic lecture system, because it is a comprehensive model that allows a system to be developed from the beginning to completion. It has five phases, namely: analysis, design, development, implementation and evaluation (Chapter 6).

3- Analyse the participants' responses in the main study

The main study will be conducted to carry out this research. Control groups and experimental groups will participate to check the proposed system. They will be chosen from different departments and they will be randomly selected. Statistical tests using SPSS Statistics will be conducted to check and analyse the significant level between groups.

Mixed methods were used to analyse the responses of participants. Quantitative and qualitative methods were applied to extract the result from both students and lecturers (Chapter 3). A total of 64 students and ten lecturers participated from the IT and Education departments. To check the level of significance between groups, statistical tests were

conducted to extract the main sources from the data. The Cronbach test was conducted to check the reliability of the questionnaire (Chapter 3). A level of 0.05 was considered to check the significance between the experiment groups. Also parametric and nonparametric tests were used depending on the normality of the data. If the data was normally distributed a parametric test was used, such as the Independent t-test and if the data was not normally distributed a nonparametric test such as the Mann-Whitney test (Chapter 7) was used. Factor analysis was conducted to check the relationship between observable variables and to ensure each dimension was measured (Chapter 8).

4- Evaluate the efficiency of applying the IELS

Mixed methods (quantitative and qualitative) will be applied to analyse data; this will also help to evaluate the efficacy of applying the IELS as a new lecturing system. Six dimensions will be evaluated, namely: accessibility, usability, interactivity, learnability, communication and satisfaction. Therefore a number of questions have been formulated to evaluate these dimensions as follows:

- *Q5 Does accessibility differ between the IELS groups?*
- *Q6 Does usability differ between the IELS groups?*
- *Q7 Does interactivity differ between the IELS groups?*
- *Q8 Does learnability differ between the IELS groups?*
- *Q9 Does communication differ between the IELS groups?*
- *Q10 Does satisfaction differ between the IELS groups?*

To evaluate the efficiency and the effectiveness of applying the IELS, six main dimensions were taken into consideration for the research questions. These dimensions were tested according to a scale from 1 to 5 and rated as 1 = Unsatisfactory, 2 = Poor, 3 = Satisfactory, 4 = Good and 5 = Outstanding, in the main study questionnaire (Appendix C). The main results were as follows:

- *Accessibility Q5 (Does accessibility differ between the IELS groups?)* was translated into five statements then rewritten as null hypotheses (Chapter 7) to check the significance between the experiment groups when they accessed the IELS. Overall results showed that there was no significance between users when they used the IELS

except between the Education students (Chapter 7). Regarding ease of accessibility to the IELS, results showed that some users (IT students, IT lecturers, and Education lecturers) were close to *Good* while the Education students were close to *Satisfactory* as shown in Chapter 8 (Table 8.3). This result reflected that the IELS was an accessible system.

- *Usability Q6 (Does usability differ between the IELS groups?)* was translated into seven statements then rewritten as null hypotheses (Chapter 7) to check the significance between the experiment groups when they accessed the IELS. Overall results showed that there was no significance between users when they used the IELS, and results showed that some users (IT students, IT lecturers, and Education lecturers) were close to *Good* while the Education students were close to *Satisfactory* as shown in Chapter 8 (Table 8.5). These result reflected that the IELS was an accessible system.

- *Interactivity Q7 (Does interactivity differ between the IELS groups?)* was translated into three statements then rewritten as null hypotheses (Chapter 7) to examine the significance between the IELS users when they interacted with this system. Overall results showed that there was no significant difference between the users when they interacted with the IELS except for the Education group where there was significant difference between the subgroups. Also, the results showed that the users were happy when they interacted with the actions in the IELS and with the lecture content, and some of their responses were close to *Good* while others were close to *Outstanding* as shown in Chapter 8 (Table 8.7). This indicates that the IELS enhanced and supported interactivity between users and lecture content which led to increased student engagement.

- *Learnability Q8 (Does learnability differ between the IELS groups?)* translated into five statements that were rewritten as null hypotheses (Chapter 7) to examine the significance of learnability of the IELS between its users. Results showed that there was no significant difference found between the IELS groups when they learned using the IELS. Results also showed that the users' responses were close to *Good* as shown in Chapter 8 (Table 8.9). This indicates that the IELS enhanced the learning process and supported the students whenever and wherever they learned. It is also an indicator

that the IELS helped to increase students' understanding and to build their knowledge in some courses.

- *Communication Q9 (Does communication differ between the IELS groups?)* translated into four statements which were rewritten as null hypotheses (Chapter 7) to examine and evaluate the significant difference between users when they communicated using the IELS. Results showed that all users found it easy to communicate and to obtain feedback from their lecturer and the IELS motivated them to concentrate on the lecture content. Also, results showed that there was no significant difference between the IELS groups when they communicated and their responses were close to *Good* as shown in Chapter 8 (Table 8.11). This indicates that communication was easy when using the IELS.

- *Satisfaction Q10 (Does satisfaction differ between the IELS groups?)* was translated into eight statements then formulated to null hypotheses. They examined and evaluated whether there was any significant difference in satisfaction between the users when they worked on IELS. Many aspects of satisfaction were considered, such as the lecture being divided into clips, length of clips, IELS format, interface style, interface colours, multimedia, and general satisfaction. Results showed that there was no significant difference between the satisfaction of users when they used the IELS and showed that all users recorded close to *Good* as shown in Chapter 8 (Table 8.13) when they submitted their responses regarding their satisfaction with the IELS.

5- Compare the IELS and the e-lecture

An empirical study will be conducted to compare the IELS and the e-lecture within the learning and communication process. An empirical study will be conducted to compare the IELS and the e-lecture within the learning and communication process. Testing of the six previously stated research dimensions will help to evaluate the learning outcomes, student interaction with lecture content and exchange of information when comparing to the e-lecture to the IELS. In order to determine whether there is a significant difference between the populations, two groups will participate in this study, the control groups (AI

and A2) and the experimental groups (B1, B2 and C1 ,C2), and the following three questions will be asked.

In order to determine whether there is a significant difference between the populations, two groups will participate in this study, the control groups (A) and the experimental groups (B&C), and two questions will be asked.

- *Q11. Do learning outcomes differ between the e-lecture groups and the IELTS groups?*
- *Q12. Does exchange of information differ between the e-lecture groups and the IELTS groups?*
- *Q13. Does interaction with lecture content differ between the e-lecture groups and the IELTS groups?*

To check the effectiveness of the lecturing method, three issues were compared in the e-lecture (control groups) and IELTS (experiment groups); namely learning outcomes, students' interaction with lecture content and exchange of information. The result stated in the previous section reflects the high performance of IELTS and also indicates its effectiveness on those three issues. In other words, it reflected high learning outcomes and achievements, positive interaction and easy communication via exchange information between IELTS users.

Pre-tests and post-tests were conducted to check whether there was a significant difference in learning outcomes between the control groups and the experimental groups as shown in Chapter 7 (Section 7.3). Results showed that there was no significant difference between the groups when their knowledge was tested in the pre-test, while they showed a significant difference in the post-test; this indicates that students who were taught using the IELTS achieved more than those who were taught using the e-lecture.

Communication is one of the obstacles faced in the e-lecture group, not only in this study but also in previous studies, because the focus was on delivering lectures to students. To compare between the communication between students and between students and their lecturer the IELTS offered a rich environment for communication and created freedom to communicate as individuals and as groups. This helped to create some respect and trust between students as well between students and their lecturer. The system record results showed that there was significant difference between the users when they exchanged information using the IELTS as shown in Chapter 7 (Section 7.4).

This research also compared the interaction of students with the lecture content. Results showed that there was no interaction between the students and lecture content in the control groups because they were listening to the lecturer and no engagement was recorded. On the other hand, there was interaction with the lecture content when students used the IELTS and the students were strongly engaged with the content of the lecture when they used the IELTS actions which motivated them to focus on the topic of the entire lecture as shown in Chapter 7 (Section 7.5).

6- Provide an innovative solution for lecturing in a novel format against the previous studies

The research will review some of the previous studies and critique them against the IELTS to establish the differences between them and the contribution this thesis will make in the field of lecturing.

Due to the increasing number of students, this research looked at an innovative solution for the lecturing system. It presented the lecture in a new format with the design and development of the IELTS. According to the qualitative study conducted in both the preliminary and main studies, the majority of participants confirmed that this system enhances the lecturing system and enables easy communication between its users. It also presents the lecture in a new style which motivates students to work, learn and interact with lecture content. In addition it provides the lecturing system with a database that helps lecturers to monitor their students and follow their progress. An advantage of this research is that it combined six dimensions and two studies when applying the IELTS as a new lecturing system which has not been done in previous studies.

9.6 Research Limitations

While the experiment in this research was conducted successfully, there were some constraints and limitations which should be addressed.

1- Number of participants

Despite the small population sample in this research, it is still reasonable when compared to previous studies in this area. However, the small number of participants could be considered as one of the research limitations. The sample was restricted to KAU, with 33 students and 14 lecturers for the preliminary study and 64 students and ten lecturers for the main study. Another issue regarding the population is that this experiment was conducted in Saudi Arabia which is a conservative Islamic country so there is no mixing between male and female students. However the system overcame this problem because there was an online connection between the genders which helped them to exchange ideas and information, and to discuss issues related to the lecture topic.

2- Time limitation

As this experiment was conducted in Saudi Arabia there was limited time to prepare the experiment in terms of obtaining approval from Durham and King Abdulaziz Universities and then finding volunteers who were able to spend time working on the system, including training, using and testing the system.

3- Lack of equipment

The experiment was conducted in the Faculty of Sciences and Art at King Abdulaziz University. The Faculty is located in Khulais which is about 60 km from the main university and is housed in a new building that is still under development and does not yet have laboratory equipment and internet service. Therefore the experiment was transferred to the main campus of KAU in Jeddah where there are many laboratories and good internet service. It took time to prepare and coordinate the experiment and train the users.

9.7 Future Work and Recommendations

This research was conducted on the design and development of a new lecturing system, the IELTS. A number of issues could be considered when building on this research to be developed in future work such as:

- 1- The experiment was conducted at King Abdulaziz University in Jeddah Saudi Arabia and should be repeated in other universities globally.
- 2- Only two departments participated in this experiment, IT and Education; it is highly recommended that this be extended to other departments which would greatly enrich the results.
- 3- The sample number was small, in particular the number of lecturers, so in the future the number could be extended to involve more participants from both students and lecturers.
- 4- Two lectures were adopted to examine the IELTS; for in-depth results regarding the effectiveness of using the IELTS, a longer term should be applied.
- 5- Two types of action were covered in this research, Click and Popup; the actions could be developed and new actions added to allow the students to interact with the lecture content.
- 6- The IELTS is a web application; this application could be developed as a mobile app which would create an opportunity for evaluation from other platforms such as mobile phones, iPads and tablets.
- 7- The IELTS was evaluated when being run and used from PCs; the effectiveness of this system should be evaluated when being run from other devices such as iPads and tablets.
- 8- This research does not cover the effectiveness and the impact of the length of video clips on students' achievement and from their perspective this point could be considered in future work.
- 9- When this system is developed there are some features which should be improved and considered as an advantage to some users such as:

- Users might control the colour of interfaces and system screens
- Users might control the themes, styles and background of the system screens
- Users might control the icons
- Some games might be added to make the system more interactive and motivation

9.8 Conclusion

This chapter has presented an overview of suggesting, designing, and developing an innovative lecturing system. It has also summarised the research experiment then addressed the research findings. When comparing the delivery of lectures using IELS to the e-lecture, the main finding of this research indicates that the IELS is more effective and supportive for the learning and communication process. It also indicates that there is a strong relationship between the research dimensions because each dimension affects the others. The results reflect the success of the lecturing system (IELS) on learning outcomes, student interaction and easy exchange of information. Originality of this research was declared when the research contributions were identified. Criteria of success were analysed and judged according to the thesis flow. In order to address the main obstacles research limitations were explained. Finally, recommendations were made for further work and development.

Appendix A

FORM EC2



UNIVERSITY OF DURHAM

School of Engineering and Computing Sciences Ethical Review

APPLICATION FORM FOR RESEARCH ETHICS APPROVAL OF WORK WITH HUMAN PARTICIPANTS

SECTION A INVESTIGATOR:

1. NAME, POST HELD, STUDENT/ACADEMIC STAFF/OTHER:

Ahmed Althobaiti PhD Student

2. E-MAIL ADDRESS, DEPARTMENT, CONTACT ADDRESS and CONTACT TELEPHONE NUMBER:

a.r.al-thobaiti@durham.ac.uk, School of Engineering and Computing Sciences
50 Newton Drive DH15BE, Durham
07435868313

3. PRINCIPAL INVESTIGATOR

Ahmed Althobaiti

4. PRINCIPAL INVESTIGATOR'S E-MAIL ADDRESS, DEPARTMENT, CONTACT ADDRESS and CONTACT TELEPHONE NUMBER

a.r.al-thobaiti@durham.ac.uk, School of Engineering and Computing Sciences
50 Newton Drive DH15BE, Durham
07435868313

5. RESEARCH SUPERVISOR OR ACADEMIC-IN-CHARGE (TEACHING):

Professor Malcolm Munro

6. RESEARCH SUPERVISOR/ACADEMIC-IN-CHARGE'S E-MAIL ADDRESS, UNIVERSITY DEPARTMENT, CONTACT ADDRESS AND TELEPHONE NUMBER

Malcolm.munro@durham.ac.uk Room number E498 School of Engineering and Computing Sciences

7. LIST ALL CO-WORKERS, THEIR: STATUS, EMPLOYER (AND DEPARTMENT), AND RESEARCH EXPERIENCE:

Professor Ahmed Ayesh Faculty of Science and Arts - Khulais King Abdul-Aziz University

8. INTENDED LOCATION/S FOR THE STUDY

Faculty of Science and Arts – Khulais, King Abdul-Aziz University, , Jeddah, Saudi Arabia

16

1-6

نموذج موافقة للمشاركة في تجربة المحاضرات التفاعلية الإلكترونية

التاريخ: 14/11/2019
 اسم المشارك:
 التخصص: معلومات المستوى الجامعي: السابع
 المعدل التراكمي: ١- من ١ إلى أقل من ٢ ٢- من ٢ إلى أقل من ٣ ٣- من ٣ إلى أقل من ٤ ٤- من ٤ إلى ٥
 السلام عليكم ورحمة الله وبركاته

شكرا لتطوعك ومشاركتك في تقييم الدراسة الخاصة بنظام المحاضرات التفاعلية الإلكترونية ستقوم بالمشاركة في الجزء الأول من هذه التجربة والذي يتضمن محاضرة تقليدية وذلك لعمل مقارنة بين هذه المحاضرة وبين المحاضرة التفاعلية الإلكترونية والتي ستعرض في الجزء الثاني من هذه التجربة. الجزء الأول من التجربة يتضمن اختيارا قريبا ثم يتم الاستماع للمحاضرة ثم اختيارا آخر بعيدا لذا ستستغرق هذه المشاركة حوالي الساعة تقريبا. أقدر لك جهودك وأستفيد مما تقدم من توصيات في هذه الدراسة كذلك لك مطلق الحرية في المشاركة في هذه التجربة أو حتى الانسحاب في أي وقت تشاء علما بأن كافة البيانات والمعلومات التي تستخلص من هذه التجربة ستكون موضع سرية تامة ويهدف البحث والدراسة فقط.

أرجو الإجابة عن الأسئلة التالية:

١- هل سبق وأن شاركت بدراسة أو تجربة حول المحاضرات التفاعلية الإلكترونية ؟

لا

٢- هل عرفت ماهو موضوع هذه التجربة ؟

لا نعم

٣- هل تمت الإجابة على كل استفساراتك بخصوص هذه الدراسة ؟

لا نعم

٤- من قام بالتعارك عن هذه التجربة ؟

.....

٥- هل تم إيهامك أن مشاركتك تطوعية وأنه يمكنك الانسحاب في أي وقت تشاء ؟

لا نعم أقبل المشاركة في هذه التجربة التوقيع: [Signature]البريد الإلكتروني: Saralla.a@hit.ac

KINGDOM OF SAUDI ARABIA
Ministry of Higher Education
KING ABDULAZIZ UNIVERSITY
Faculty of Sciences and Arts
Khulais

Ref :

Date : / / 143

Encl:



رئيس قسم مهارات الاتصال
Head of Communication Skills Department

المملكة العربية السعودية
وزارة التعليم العالي
جامعة الملك عبدالعزيز
كلية العلوم والآداب
خليص

مرجع :

تاريخ : 12/14 / 1415 هـ

مرفقات :

إفادة إتمام رحلة علمية

المحترم سعادة الملحق الثقافي بالمملكة المتحدة وبارنلد

وبعد السلام عليكم ورحمة الله وبركاته

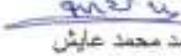
تفيدكم علما بأن الطالب: أحمد رده محمد التنبتي المبعث من قسم مهارات الاتصال بجامعة الملك عبد العزيز قد قام بإجراء الدراسة العلمية لمشروع بحثه في جامعة الملك عبد العزيز بجدة بكلية العلوم والآداب بخص حيث شملت تلك الخطة توزيع الاستبيانات على المستطلعين و عمل الاختبارات القبلية والبعدية وتطبيق النظام المقترح وقد قام بإتمام الرحلة العلمية حسب الخطة المعدة مسبقا حيث بدأ بتنفيذ التجربة بتاريخ

2013/12/5 وتم الانتهاء من تنفيذها بتاريخ 2014 /3/7

ولكم خالص تحياتي وتقديري،

جامعة الملك عبد العزيز بجدة

رئيس قسم مهارات الاتصال بكلية العلوم والآداب بخص


أ.د. أحمد محمد عايش

2014/10/13

الموقع على شبكة الإنترنت
sak.rjb.kau.edu.sa

ص.ب. 355 خليص 21921
P.O. Box 355, Khulais 21921

هاتف: 2135892
Tel. : 2135892



خطة الرحلة العلمية خلال ثلاثة أشهر من 5- ديسمبر 2013 وحتى 7- مارس 2014

الشهر	الأسبوع الأول	الأسبوع الثاني	الأسبوع الثالث	الأسبوع الرابع
31---5 ديسمبر 2013		الاتصال بإدارة البعثات والحصول على خطاب تنفيذ التجربة	إعداد الاستبيانات الأولية والتنسيق مع أعضاء هيئة التدريس بالكلية	إجراء الاستبيانات الأولية مع بعض أعضاء هيئة التدريس وبعض الطلاب
31---1 يناير 2014	جمع البيانات وتنظيمها	تجهيز المادة العلمية ورفعها على النظام	الإعداد لتنفيذ التجربة وتجهيز الاختبارات واختبار النظام	عمل تدريب للمستخدمين على النظام
31---1 فبراير 2014	عمل اختبار قبلي للمجموعتين الضابطة والتجريبية	إجراء التجربة الأولى Traditional Lecture Group A المجموعة الضابطة	إجراء التجربة الثانية IELS Group B المجموعة التجريبية	إجراء الاختبار البعدي للمجموعتين
7---1 مارس 2014	عمل الاستبانة النهائية لمستخدمي النظام (محاضرون وطلاب) جمع البيانات			

Appendix B

Preliminary Questionnaire (Form PQ1)

Name :(Optional).....

Gender: Male, Female

Department:.....

University Level : 1 , 2 , 3 , 4

Grade 1>2 , 2>3 , 3>4, 4-5

No	Question	Please tick the appropriate answer				
1	How often do you usually use the internet for learning?	<input type="checkbox"/> Always	<input type="checkbox"/> Often	<input type="checkbox"/> Sometime	<input type="checkbox"/> Never	
2	What do you mostly focus on when using the internet?	<input type="checkbox"/> Fun & game	<input type="checkbox"/> Read News	<input type="checkbox"/> Social Networks	<input type="checkbox"/> Learning	<input type="checkbox"/> Everything
3	What type of lecture is delivered in your college?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
4	Does your college deliver lectures for all students on its website?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
5	What type of lecture is delivered in your college website?	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
6	Do you think there is a need to see your lectures via your college website?	<input type="checkbox"/> E-lecture	<input type="checkbox"/> Online lectures	<input type="checkbox"/> Presentation Slides	<input type="checkbox"/> Interactive lectures	<input type="checkbox"/> Other
7	Do you prefer traditional lectures or online lectures?	<input type="checkbox"/> E-lecture	<input type="checkbox"/> Online lectures			
8	In the case of electronic lectures do you prefer to watch an entire online lecture all at once, or in short interactive clips?	<input type="checkbox"/> Whole lecture once	<input type="checkbox"/> Short interactive clips	<input type="checkbox"/> Both		
9	In your opinion, is it more useful to just watch the lecture or to	<input type="checkbox"/> Just watch	<input type="checkbox"/> Watch and interact			

APPENDIX B

No	Question	Please tick the appropriate answer				
	watch and interact with it?					
10	Q10- Are you interested in learning via interactive web applications?	<input type="checkbox"/> Very interested	<input type="checkbox"/> Interested	<input type="checkbox"/> Don't care		
11	Q11- How often do you communicate online with your lecturer?					

10- Please give your opinion regarding the developing of a new lecturing system to enhance learning communication and interaction.

.....

Preliminary Questionnaire (Form PQ2)

Name :(Optional)..... Gender: Male, Female Department:.....

Years of your expertise: 5-10, 11-20, More than 20 Level of computer skills: Satisfied, Good, excellent

No	Question	Please tick the appropriate answer					
1	How often do you use the internet to communicate with your students?	<input type="checkbox"/> Always	<input type="checkbox"/> Often	<input type="checkbox"/> Sometime	<input type="checkbox"/> Never		
2	What do you mostly focus on when using your college website?	<input type="checkbox"/> Set up the timetable of lectures	<input type="checkbox"/> Communicate with my students	<input type="checkbox"/> Upload my lecture slides	<input type="checkbox"/> Give my students useful links	<input type="checkbox"/> Everything	<input type="checkbox"/> Other
3	Which methods do you use to deliver your lectures?	<input type="checkbox"/> Traditional lectures	<input type="checkbox"/> E-lectures	Interactive lectures	Others		
4	Does your college offer lectures for all students on its website?	<input type="checkbox"/> Yes	<input type="checkbox"/> No				
5	If you answered yes to Question 4, what kind of lectures are offered?	<input type="checkbox"/> E-lectures	<input type="checkbox"/> Recorded lectures	Live lectures	Interactive lectures	Others	
6	If you answered yes to Question 4, what kind of students is allowed access to these lectures?	<input type="checkbox"/> All students	<input type="checkbox"/> Absent students	<input type="checkbox"/> Full time students	<input type="checkbox"/> Part time students		

APPENDIX B

No	Question	Please tick the appropriate answer					
7	How interested are you in teaching your students by interactive web application?	<input type="checkbox"/> Very interested	<input type="checkbox"/> Interested	<input type="checkbox"/> Don't care			
8	Do you think the traditional lecture is still the most suitable way to deliver lectures to students?	<input type="checkbox"/> Yes	<input type="checkbox"/> No				
9	Do you think there is a need to create interactive electronic lectures?	<input type="checkbox"/> Yes	<input type="checkbox"/> No				
10	Do you think interactive electronic lectures will have a positive effect on student achievements?	<input type="checkbox"/> Yes	<input type="checkbox"/> No				
11	In the case of electronic lectures do you suggest the delivery of interactive electronic lectures should be all at once, or as short interactive clips, or both?	<input type="checkbox"/> Whole lecture	<input type="checkbox"/> Short interactive clips	<input type="checkbox"/> Both			
12	Who do you think would benefit from interactive electronic lectures?	<input type="checkbox"/> All students	<input type="checkbox"/> Absent students	<input type="checkbox"/> Full time students	<input type="checkbox"/> Part time students		

Please give your opinion regarding the developing of a new lecturing system to enhance learning, communication and interaction.

.....

Appendix C

Name: _____ Department: _____ GPA: _____
 User State: Student University level: _____ Gender: M / F
 Please circle the appropriate number which indicates your agreement level of using IELS
 with the following statements as:
 5 = Outstanding 4 = Good 3 = Satisfactory 2 = Poor 1 = Unsatisfactory

No	Criteria categories	Statement	Outstanding ---- Unsatisfactory				
			O	G	S	P	U
1	IELS Accessibility	It was easy to register with IELS	5	4	3	2	1
2		It was easy to sign in with IELS	5	4	3	2	1
3		It was easy to sign out with IELS	5	4	3	2	1
4		It was easy to run IELS	5	4	3	2	1
5		It was easy to access the content of IELS	5	4	3	2	1
6	IELS Usability	It was easy to use IELS	5	4	3	2	1
7		It was easy to edit my personal settings in IELS	5	4	3	2	1
8		It was easy to view my modules using IELS	5	4	3	2	1
9		It was easy to view my lectures using IELS	5	4	3	2	1
10		It was easy to view my video clips using IELS	5	4	3	2	1
11		It was easy to view my credits using IELS	5	4	3	2	1
12		It was easy to navigate using IELS	5	4	3	2	1
13	IELS Interactivity	IELS offered me interactivity with lecture contents more than the e-lecture	5	4	3	2	1
14		Popup actions enhanced my level of interactivity	5	4	3	2	1
15		IELS fosters my ability to use technology in learning	5	4	3	2	1
16	IELS Learnability	It was easy to learn from IELS	5	4	3	2	1
17		IELS actions are easy to learn from	5	4	3	2	1
18		IELS offered learning to me for any time I wanted	5	4	3	2	1
19		IELS facilitates the learning process	5	4	3	2	1
20		IELS offered me more learning than the e-lecture	5	4	3	2	1
21	IELS Communication	It was easy to communicate with my lecturer using IELS	5	4	3	2	1
22		It was easy to get feedback from my lecturer using IELS	5	4	3	2	1
23		It was easy to send message to any user via IELS	5	4	3	2	1
24		It was easy to chat with any user via IELS	5	4	3	2	1
25	IELS Satisfaction	Dividing lecture into clips is better than the whole lecture	5	4	3	2	1
26		Video clips time duration was appropriate	5	4	3	2	1
27		IELS style presents a lecture in a new format to me	5	4	3	2	1
28		IELS style interface designs are familiar to me	5	4	3	2	1
29		IELS style interface colours are familiar to me	5	4	3	2	1
30		IELS style multimedia is familiar to me	5	4	3	2	1
31		I am satisfied with IELS operation	5	4	3	2	1
32	I am satisfied with IELS speed	5	4	3	2	1	

Please submit your feedback and suggestion in general about using the IELS

.....

APPENDIX C

Form MQ2

Name: Department: Years of expertise:

User State: Lecturer Gender: M / F

Please circle the appropriate number which indicates your agreement level of using IELS with the following statements as:

5 = Outstanding 4 = Good 3 = Satisfactory 2 = Poor 1 = Unsatisfactory

No	Criteria categories	Statement	Outstanding ---- Unsatisfactory				
			O	G	S	P	U
1	IELS Accessibility	It was easy to register with IELS	5	4	3	2	1
2		It was easy to sign in with IELS	5	4	3	2	1
3		It was easy to sign out with IELS	5	4	3	2	1
4		It was easy to run IELS	5	4	3	2	1
5		It was easy to access the content of IELS	5	4	3	2	1
6	IELS Usability	It was easy to use IELS	5	4	3	2	1
7		It was easy to edit my personal settings in IELS	5	4	3	2	1
8		It was easy to set up my modules using IELS	5	4	3	2	1
9		It was easy to set up my lectures using IELS	5	4	3	2	1
10		It was easy to upload clips using IELS	5	4	3	2	1
11		It was easy to view my students report using IELS	5	4	3	2	1
12		It was easy to navigate using IELS	5	4	3	2	1
13	IELS Interactivity	IELS offered my students interactivity with lecture contents more than the e-lecture	5	4	3	2	1
14		Popup actions enhanced the level of interactivity of my students	5	4	3	2	1
15		IELS fosters my ability to use technology in learning	5	4	3	2	1
16	IELS Learnability	It was easy for my students to learn from IELS	5	4	3	2	1
17		It was easy to learn using IELS actions	5	4	3	2	1
18		IELS offered learning to my student at any time they wanted	5	4	3	2	1
19		IELS facilitates the learning process for my students	5	4	3	2	1
20		IELS offered my students more learning than the e-lecture	5	4	3	2	1
21	IELS Communication	It was easy to communicate with my students using IELS	5	4	3	2	1
22		It was easy to get feedback from my students using IELS	5	4	3	2	1
23		It was easy to send message to any user via IELS	5	4	3	2	1
24		It was easy to chat with any user via IELS	5	4	3	2	1
25	IELS Satisfaction	Dividing lecture into clips is better than the whole lecture	5	4	3	2	1
26		Clips time duration was appropriate	5	4	3	2	1
27		IELS style presents a lecture in a new format to me	5	4	3	2	1
28		IELS style interface designs are familiar to me	5	4	3	2	1
29		IELS style interface colours are familiar to me	5	4	3	2	1
30		IELS style multimedia is familiar to me	5	4	3	2	1
31		I am satisfied with IELS operation	5	4	3	2	1
32		I am satisfied with IELS speed	5	4	3	2	1

Please submit your feedback and suggestion in general about using the IELS

.....

Popup Action

L 1

تقييم نظام المحاضرات التفاعلية الإلكترونية

الاسم: الجنس: ١- ككي ٢- أنثى القسم: سنوات الخبرة:

ضع دائرة حول الرقم الذي تعتقد أنه مناسب لتقييمك لنظام المحاضرات التفاعلية الإلكترونية في كل فقرة ممايلي حيث أن

رقم ٥ يعني ممتاز ورقم ٤ يعني جيد جدا ورقم ٣ يعني جيد ورقم ٢ يعني مرضى ورقم ١ يعني ضعيف

تسلسل	معايير التصنيف	الفقرة	ممتاز	جيد جدا	جيد	مرضى	ضعيف
١	سهولة الوصول لنظام المحاضرات التفاعلية الإلكترونية	كان من السهل التسجيل بالنظام	٥	٤	٣	٢	١
٢		كان من السهل الدخول للنظام	٥	٤	٣	٢	١
٣		كان من السهل الخروج من النظام	٥	٤	٣	٢	١
٤		كان من السهل تشغيل النظام	٥	٤	٣	٢	١
٥		كان من السهل تشغيل النظام من أي جهاز	٥	٤	٣	٢	١
٦	استخدام نظام المحاضرات التفاعلية الإلكترونية	كان من السهل استخدام النظام	٥	٤	٣	٢	١
٧		كان من السهل تحرير الإعدادات الشخصية	٥	٤	٣	٢	١
٨		كان من السهل استعراض قائمة المقررات	٥	٤	٣	٢	١
٩		كان من السهل استعراض قائمة المحاضرات	٥	٤	٣	٢	١
١٠		كان من السهل استعراض قائمة المقاطع	٥	٤	٣	٢	١
١١		كان من السهل استعراض الرصيد	٥	٤	٣	٢	١
١٢		كان من السهل التنقل بين شاشات النظام	٥	٤	٣	٢	١
١٣		التفاعل مع النظام	النظام حقق لطلابي تفاعل أكبر مع محتوى المحاضرة مما يحدث في المحاضرات التقليدية	٥	٤	٣	٢
١٤	الإسئلة المتبقية زادت معدل تفاعل طلابي مع المحاضرة		٥	٤	٣	٢	١
١٥	هذا النظام سرع من قدرتي لاستخدام التكنولوجيا في عملية التعلم		٥	٤	٣	٢	١
١٦	التعلم باستخدام نظام المحاضرات التفاعلية الإلكترونية	كان من السهل التعلم باستخدام النظام	٥	٤	٣	٢	١
١٧		الإطار المنبثق سهل عملية التعلم لطلابي	٥	٤	٣	٢	١
١٨		من السهل التعلم باستخدام النظام في أي وقت	٥	٤	٣	٢	١
١٩		النظام يسهل لطلابي عملية التعلم	٥	٤	٣	٢	١
٢٠	النظام سهل لطلابي عملية التعلم أكثر من المحاضرة التقليدية	٥	٤	٣	٢	١	
٢١	محتويات وشكل نظام المحاضرات التفاعلية الإلكترونية	تقسيم المحاضرة إلى وحدات قصيرة أفضل من عرضها دفعة واحدة	٥	٤	٣	٢	١
٢٢		المدة الزمنية لكل مقطع كانت مناسبة	٥	٤	٣	٢	١
٢٣		النظام قدم لي المحاضرة في شكل مثير	٥	٤	٣	٢	١
٢٤		أجهزة النظام قريبة من متطلباتي	٥	٤	٣	٢	١
٢٥		ألوان وأجهزة النظام مناسبة لي	٥	٤	٣	٢	١
٢٦	الوسائط المستخدمة في النظام مناسبة لي	٥	٤	٣	٢	١	
٢٧	التواصل باستخدام نظام المحاضرات التفاعلية الإلكترونية	كان من السهل التواصل مع الطلاب	٥	٤	٣	٢	١
٢٨		كان من السهل الحصول على التغذية الراجعة من الطلاب	٥	٤	٣	٢	١
٢٩		النظام حفز طلابي للتركيز على مضمون المحاضرة	٥	٤	٣	٢	١
٣٠		النظام حفزني لاستخدامه بدلا عن المحاضرة التقليدية	٥	٤	٣	٢	١
٣١	مستوى الرضا عن النظام	استمتعت باستخدام هذا التطبيق التفاعلي	٥	٤	٣	٢	١
٣٢		بصورة عامة أنا راض عن هذا النظام	٥	٤	٣	٢	١

L4

Click Action

تقييم نظام المحاضرات التفاعلية الالكترونية

الاسم:..... الجنس: ١- ذكر ٢- أنثى القسم:..... سنوات الخبرة:.....

ضع دائرة حول الرقم الذي تعتقد أنه مناسب لتقييمك لنظام المحاضرات التفاعلية الالكترونية في كل فقرة مما يلي حيث أن

رقم ٥ يعني ممتاز ورقم ٤ يعني جيد جدا ورقم ٣ يعني جيد ورقم ٢ يعني مرضى ورقم ١ يعني ضعيف

تسلسل	معايير التصنيف	الفقرة	ممتاز	جيد جدا	جيد	مرضى	ضعيف
١	سهولة الوصول لنظام المحاضرات التفاعلية الالكترونية	كان من السهل التسجيل بالنظام	٥	٤	٣	٢	١
٢		كان من السهل الدخول للنظام	٥	٤	٣	٢	١
٣		كان من السهل الخروج من النظام	٥	٤	٣	٢	١
٤		كان من السهل تشغيل النظام	٥	٤	٣	٢	١
٥		كان من السهل تشغيل النظام من أي جهاز	٥	٤	٣	٢	١
٦	استخدام نظام المحاضرات التفاعلية الالكترونية	كان من السهل استخدام النظام	٥	٤	٣	٢	١
٧		كان من السهل تحرير الإعدادات الشخصية	٥	٤	٣	٢	١
٨		كان من السهل استعراض قائمة المقررات	٥	٤	٣	٢	١
٩		كان من السهل استعراض قائمة المحاضرات	٥	٤	٣	٢	١
١٠		كان من السهل استعراض قائمة المقاطع	٥	٤	٣	٢	١
١١	التفاعل مع النظام	كان من السهل استعراض الرصيد	٥	٤	٣	٢	١
١٢		كان من السهل التنقل بين شاشات النظام	٥	٤	٣	٢	١
١٣		النظام حقق لطلابي تفاعل أكبر مع محتوى المحاضرة مما يحدث في المحاضرات التقليدية	٥	٤	٣	٢	١
١٤		التقر الزمني بالفقرة زاد معدل تفاعل طلابي مع المحاضرة	٥	٤	٣	٢	١
١٥		هذا النظام سرع من قدرتي لاستخدام التكنولوجيا في عملية التعلم	٥	٤	٣	٢	١
١٦	التعلم باستخدام نظام المحاضرات التفاعلية الالكترونية	كان من السهل التعلم باستخدام النظام	٥	٤	٣	٢	١
١٧		التقر الزمني بالفقرة سهل عملية التعلم لطلابي	٥	٤	٣	٢	١
١٨		من السهل التعلم باستخدام النظام في أي وقت	٥	٤	٣	٢	١
١٩		النظام يسط لطلابي عملية التعلم	٥	٤	٣	٢	١
٢٠		النظام سهل لطلابي عملية التعلم أكثر من المحاضرة التقليدية	٥	٤	٣	٢	١
٢١	محتويات وشكل نظام المحاضرات التفاعلية الالكترونية	تقسيم المحاضرة إلى وحدات قصيرة أفضل من عرضها دفعة واحدة	٥	٤	٣	٢	١
٢٢		المدة الزمنية لكل مقطع كانت مناسبة	٥	٤	٣	٢	١
٢٣		النظام قدم لي المحاضرة في شكل مبتكر	٥	٤	٣	٢	١
٢٤		واجهات النظام قريبة من متطلباتي	٥	٤	٣	٢	١
٢٥		الوان واجهات النظام مناسبة لي	٥	٤	٣	٢	١
٢٦		الوسائط المستخدمة في النظام مناسبة لي	٥	٤	٣	٢	١
٢٧	التواصل باستخدام نظام المحاضرات التفاعلية الالكترونية	كان من السهل التواصل مع الطلاب	٥	٤	٣	٢	١
٢٨		كان من السهل الحصول على التغذية الراجعة من الطلاب	٥	٤	٣	٢	١
٢٩		النظام حفز طلابي للتركيز على مضمون المحاضرة	٥	٤	٣	٢	١
٣٠		النظام حفزني لاستخدامه بدلا عن المحاضرة التقليدية	٥	٤	٣	٢	١
٣١	مستوى الرضا عن النظام	استمتعت باستخدام هذا التطبيق التفاعلي	٥	٤	٣	٢	١
٣٢		بصورة عامة أنا راض عن هذا النظام	٥	٤	٣	٢	١

١٦

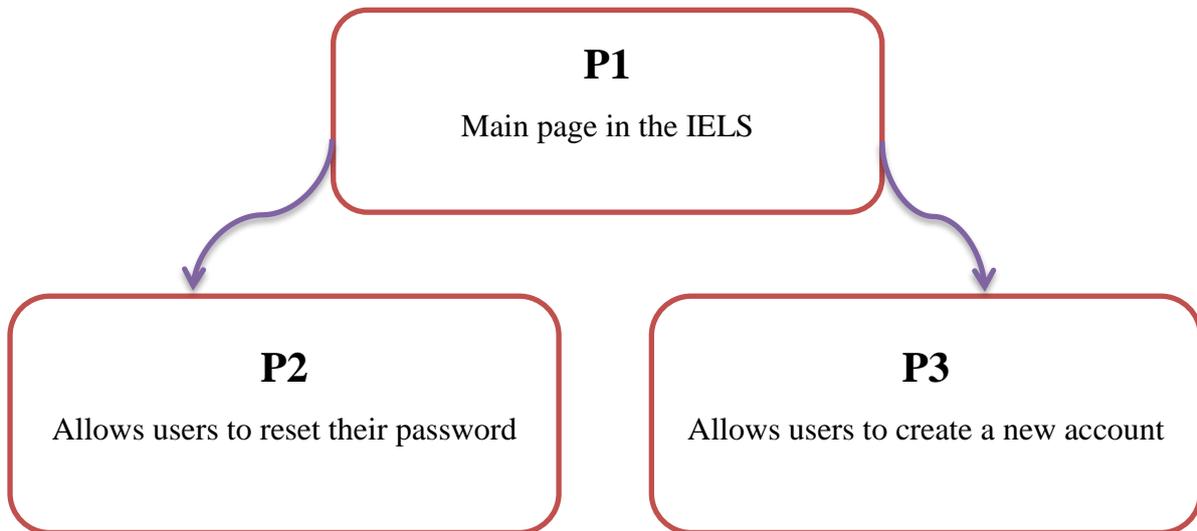
الاختبار (البياس) لتجربة المحاضرة (المطيري)

ضع إشارة صح أو خطأ في مائتي:

- ١- وسائط النقل عبارة عن مسار فيزيائي يربط أجهزة الحواسيب بعضها ببعض (✓)
- ٢- الطبقة الفيزيائية هي وسيط الاتصال غير المباشر في كوابل الاتصال (✓) (X)
- ٣- تنقسم الطبقات الفيزيائية إلى نوعين طريق موجه وطريق غير موجه (X) (X)
- ٤- الفراغ هو الطبقة الفيزيائية الموجه (✓) (X)
- ٥- UTP RJ-54 هو الموصل للكابل ويكون ذكرًا فقط (✓) (X)
- ٦- يتكون موصل البوتني بي من ثمانية خطوط كل اثنان منها أحدهما سالب والآخر موجب (X) (X)
- ٧- كوابل الشبكة عبارة عن أصناف بعضها يعمل بتقنية ديجيتال وبعضها بتقنية التناظر (✓)
- ٨- تابل الشبكة سرعة ١٠٠ ميغا أكثر الكوابل انتشارًا وتستخدم للشبكات غير العملية (✓) (X)
- ٩- الألياف الضوئية ينبغي أن تكون ذات كثافة عالية في النواة حتى تتم عملية الانعكاس العنوني (X) (X)
- ١٠- الألياف الضوئية كمادة تعتمد على خاصية هما البلاستيك فقط (X)
- ١١- تنقسم الألياف الضوئية إلى نمط مفرد ونمط متعدد (X) (X)
- ١٢- في الألياف الضوئية النواة الرفيعة تناسب النمط المفرد بينما العريضة تناسب النمط المتعدد (X) (X)
- ١٣- موجات الأنفرا رد محصورة بين ٣٠٠ فيقاهيرتز إلى ٦٠٠ تيرا هيرتز (✓) (X)
- ١٤- موجات الأشعة الغير مرئية تكون في مستوى بين ٣ ميغا هيرتز إلى ٤٠٠ تيرا هيرتز (✓) (X)
- ١٥- موجات الراديو تستخدم فقط في الإرسال لأجهزة محددة (✓)

4
15

Appendix D



- P1:** This is the first page in the system
- 1-Name of the IELS in Arabic.
 - 2-Users enter their email address.
 - 3-Users enter their password.
 - 4-Users log into the IELS if they already have an active account.
 - 5-If users forget their password it navigates to PQ2
 - 6-If users want to register it navigates to P3.
 - 7- IELS logo.



P2: This page allows users to reset their password if they have forgotten.

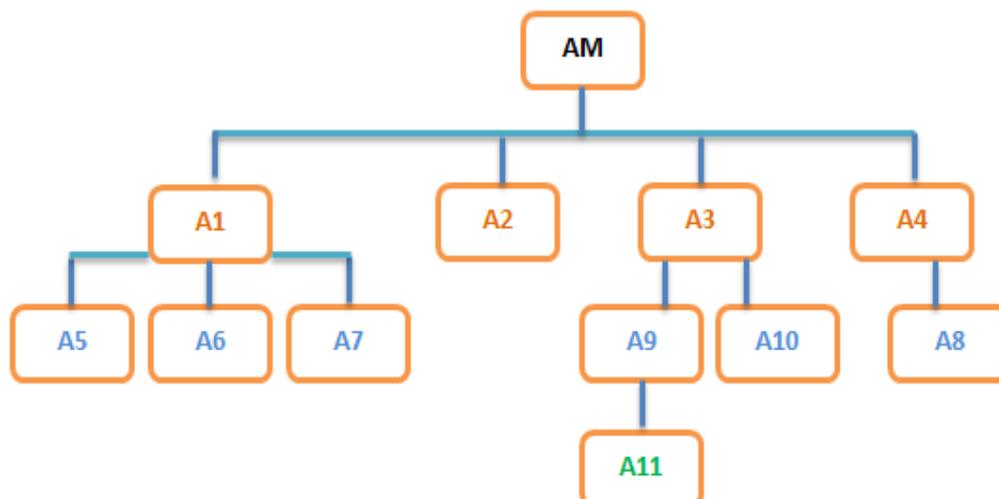
- 1-Users enter their email address
- 2-Users click this button so the system automatically will send them a link to reset their new password.
- 3- User cancel, then it navigates back to PQ1.



P3: This page allows users to create a new account in the IELS.

- 1-Users enter their first name.
- 2-Users enter their last name.
- 3-Users enter their email address.
- 4-Users enter their ID number.
- 5-Users enter their password.
- 6-Users confirm their password.
- 7-Users enter their user - status / student or lecturer
- 8-Users tick to accept the IELS registration process
- 9-Users complete their registration and click this button which will display the message “your account already has been created, wait for activation”.
- 10-Users can cancel the process, then it navigates back to PQ1.



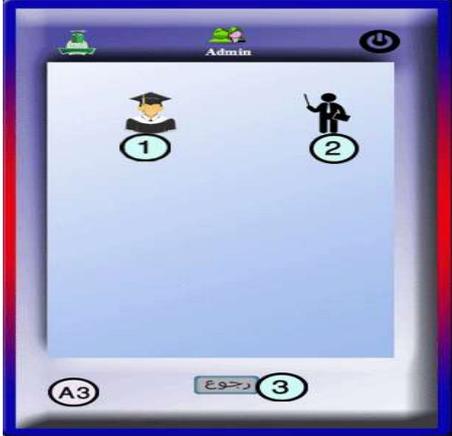
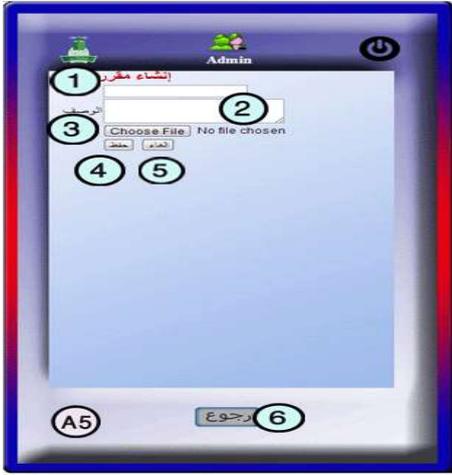


AM: This is the home page for the IELTS administrator.
 1-IELS logo
 2-Administrator name icon
 3- Administrator can sign out of the IELTS.
 4- Administrator can manage the modules, it navigates to A1.
 5-Administrator can manage the personal settings, it navigates to A2.
 6- Administrator can manage users' accounts, it navigates to A3
 7- Administrator can manage the messages box, it navigates to A4.

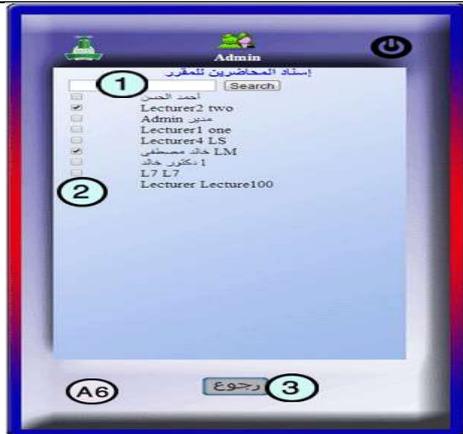


A1: This page is a list of created modules in the IELTS.
 1-Indicates the module name.
 2- Indicates the module icon.
 3- Administrator can create a new module, it navigates to A5
 4-(Lecturers) Administrator can assign the lectures to the module, it navigates to A6.
 5- (Amend) Administrator can amend the module information it navigates to A7.
 6- (Delete) Administrator can delete a module.
 7- Administrator can return to the main page, it navigates to AM

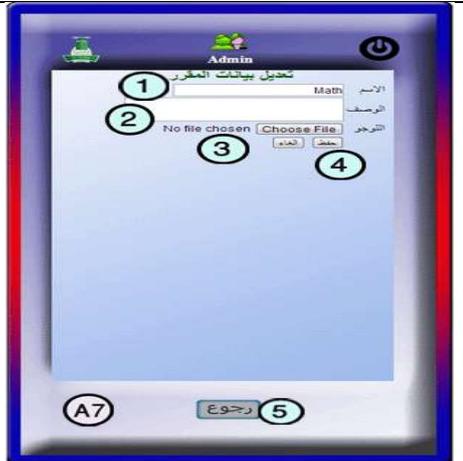


<p>A3- This page is for users' account managers</p> <ol style="list-style-type: none"> 1- Administrator can manage the student's account, it navigates to page A8. 2- Administrator can manage the lecturer's account, it navigates to page A9. 3- Administrator can go back, it navigates to page AM. 	
<p>A4- This page is a list of administrators' inbox messages</p> <ol style="list-style-type: none"> 1- Administrator can send a new message, it navigates to page A8 2- Administrator can manage inbox messages. 3- Administrator can manage outbox messages. 4- Administrator can delete marked messages. 	
<p>A5- This page is to create the new module.</p> <ol style="list-style-type: none"> 1- Administrator enters the module name 2- Administrator enters the module description 3- Administrator uploads a module logo 4- Administrator can save changes 5- Administrator can cancel the process. 6- Administrator can go back, it navigates to page A1. 	

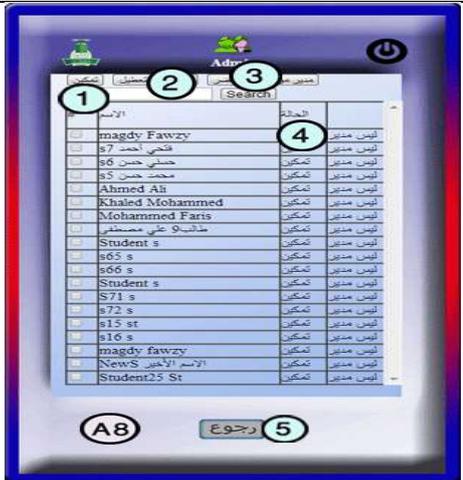
A6-This page is a list of lecturers assigned to modules
 1- Administrator can search and find a lecturer by name
 2- Administrator can tick to assign a lecturer to the module
 3- Administrator can go back, it navigates to page A1



A7- This page is to edit the module information
 1- Administrator can edit module information (name, description icon)
 2- Administrator can save changes
 3- Administrator can cancel changes
 4- Administrator can go back, it navigates to page A1

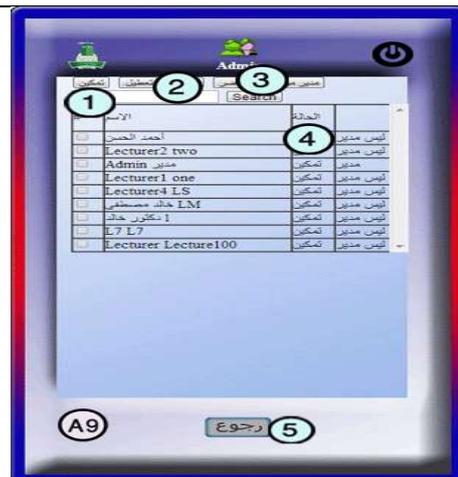


A8-This page is a list of students already registered for the IELTS
 1- Administrator can select and tick a student and activate their account
 2- Administrator can select and tick a student and disable their account
 3- Administrator can search to find a particular student on the list
 4- Administrator status (active or inactive)
 5- Administrator can go back, it navigates to page A3



A9-This page is a list of lecturers already registered in the IELS

- 1- Administrator can select and tick a lecturer and activate their account
- 2- Administrator can select and tick a lecturer and disable their account
- 3- Administrator can search to find a particular lecturer on the list
- 4- Lecturer status (active or not inactive)
- 5- Administrator can go back, it navigates to page A3



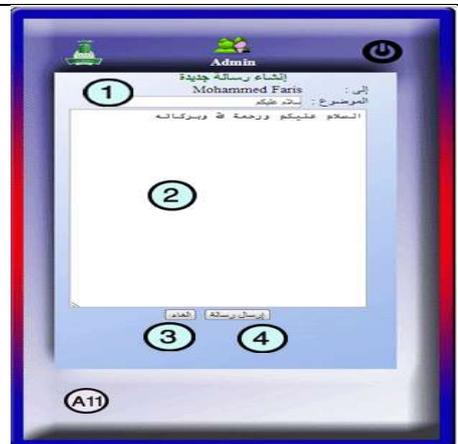
A10-This page is a list of all users in the IELS

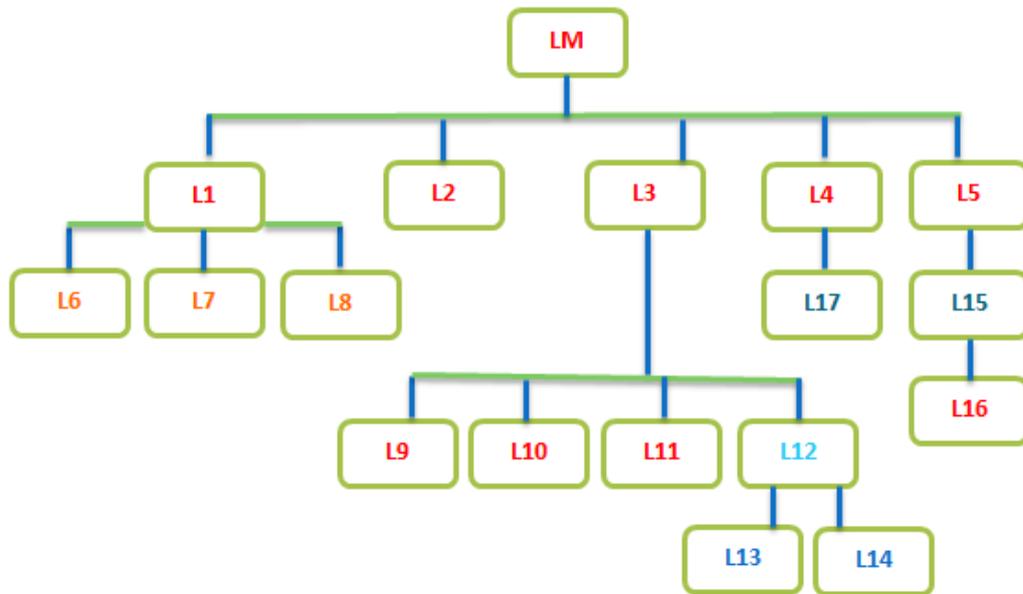
- 1- Is a list of users in the IELS
- 2- Administrator can select user , it navigates to page A11
- 3- Administrator can go back, it navigates to page A4



A11-This page is to create a new message

- 1- Administrator can enter the subject for a new message
- 2- Administrator can write a message in this box
- 3- Administrator can send a message. it navigates to A4
- 4- Administrator can cancel sending, it navigates to page A4





LM: This is the home page for the lecturers in the IELS.
 1-Lecturers can manage their lectures, it navigates to L1.
 2-Lecturers can manage their personal settings, it navigates to L2.
 3-Lecturers can manage video clips, it navigates to L3
 4-Lecturers can manage their mail messages box, it navigates to L4.
 5-Lecturers can view their students' reports, it navigates to L5.



L1: This page is a list of lectures created for a specific lecturer in the IELTS.

- 1-Indicates the lecture name.
- 2-Indicates the module name.
- 3- Lecturers can create a new lecture, it navigates to L6
- 4-(Students) Lecturers can assign the students to the lecture, it navigates to L7.
- 5- (Amend) Lecturers can amend the lecture information it navigates to L8.
- 6- (Delete) Lecturers can delete a lecture.
- 7- Lecturers can go back to the main page, it navigates to LM.



L2- This page is for lecturers' personal settings.

- 1- Lecturers can edit their first name.
- 2- Lecturers can edit their last name.
- 3- Lecturers can edit their email address.
- 4- Lecturers can edit their password.
- 5- Lecturers can confirm their password.
- 6- Lecturers can save amended settings.
- 7- Lecturers can cancel, it navigates to LM.
- 8- Lecturers can go back, it navigates to page LM.



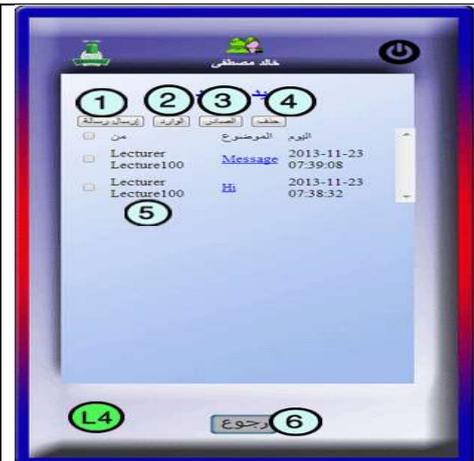
L3- This page is a list of created clips for specific lecturers in the IELTS.

- 1-Indicates the lecture name.
- 2-Indicates the clip name, it navigates to L12
- 3-(Students) Lecturers can assign the students to the lecture, it navigates to L7.
- 4-(Delete) Lecturers can delete a clip.
- 5-Lecturers can create a new clip, it navigates to L9
- 6-(Alerts) Lecturers can add some interactive actions for the clip, it navigates to L10.
- 7-(Amend) Lecturers can amend the clip information, it navigates to L11.
- 8-Lecturers can go back to the main page, it navigates to LM.



L4-This page is a list of lecturers' inbox messages

- 1-Lecturers can send a new message, it navigates to page A10
- 2-Lecturers can manage inbox messages.
- 3-Lecturers can manage outbox messages.
- 4-Lecturers can delete marked messages.
- 8-List of Inbox messages
- 6-Lecturers can go back to the main page, it navigates to LM.



L5-This page is a list of students' reports

- 1-It indicates the name of lecture
- 2- It indicates the icon of lecture
- 3- Students, it navigates to L15
- 4-Lecturers can go back to the main page, it navigates to LM.



L6- This page is to create a new lecture.

- 1-Lecturer enters a lecture name
- 2-Lecturer enters a lecture description
- 3-Lecturer uploads a lecture logo
- 4-Lecturer can assign the lecture to the module
- 4-Lecturer can save changes
- 5-Lecturer can cancel process.
- 6-Lecturer can go back, it navigates to page L1.



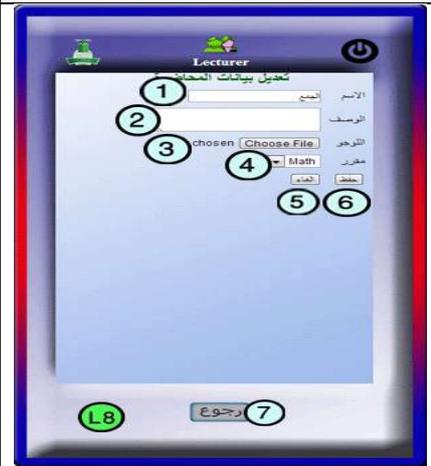
L7- This page is a list of students assigned to a lecture

- 1- Lecturer can search and find lecture by name
- 2- Lecturer can tick to assign a lecturer to the module
- 3- Lecturer can go back, it navigates to page L1



L8- This page is to edit the lecture information (name, description, icon)

- 1- Lecturer can edit lecture name
- 2- Lecturer can edit lecture description
- 3- Lecturer can edit lecture icon
- 4- Lecturer can edit module name
- 5- Lecturer can save changes
- 6- Lecturer can cancel changes
- 7- Lecturer can go back, it navigates to page L1



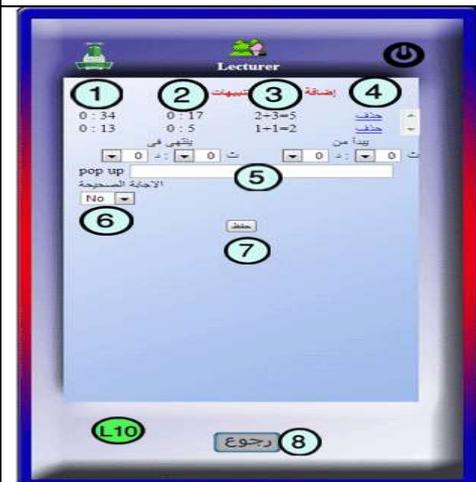
L9- This page is to create an interactive clip.

- 1-Lecturer enters a clip name
- 2- Lecturer enters a clip description
- 3- Lecturer uploads a clip file
- 4- Lecturer uploads a clip icon
- 5- Lecturer can assign the clip to the lecture
- 6- Lecturer can identify the type of clip
Popup/Click
- 7- Lecturer can save changes
- 8-Lecturer can go back, it navigates to page L3.



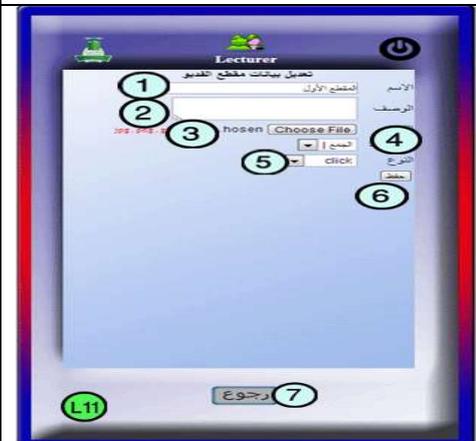
L10- This page is to add interactive actions to the clip.

- 1-It indicates the end time of action by second
- 2-It indicates the start time of action by second
- 3- It indicates the question
- 4- Lecturer can delete action
- 5- Lecturer can create action (popup question)
- 6- Lecturer can identify the type of right answer
Yes/No
- 7- Lecturer can save changes
- 8-Lecturer can go back, it navigates to page L3.



L11- This page is to edit an interactive clip.

- 1-Lecturer edits a clip name
- 2- Lecturer edits a clip description
- 3- Lecturer uploads a clip file
- 4- Lecturer can edit the clip to the lecture
- 5- Lecturer can change the type of clip (popup/click)
- 6- Lecturer can save changes
- 7-Lecturer can go back, it navigates to page L3.



L12- This page is the interactive page
 1-It indicates the clip
 2-It indicates clip action (popup question)
 3-It indicates the chat room, navigates to L14
 4-Lecturer can go back, it navigates to page L3.



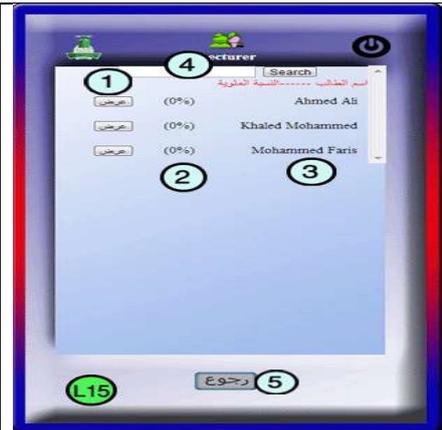
L13- This page is the interactive page
 1-It indicates the clip
 2- It indicates clip action (click here)
 3- It indicates the chat room, navigates to L14
 4-Lecturer can go back, it navigates to page L3.



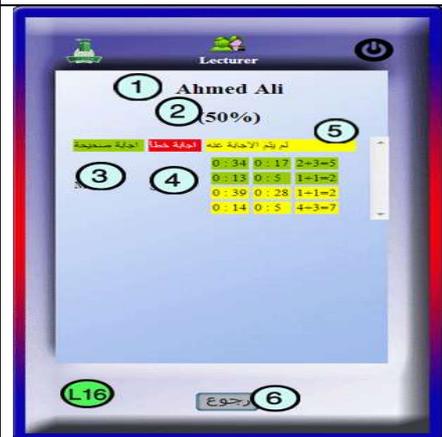
L14- This page is a chat room
 1-Lecturers can write feedback or ask students questions or answer them
 2-Lecturers can post their responses to their students
 3-List of chat between users in the same lecture
 4-Lecturers can go back, it navigates to page LM.



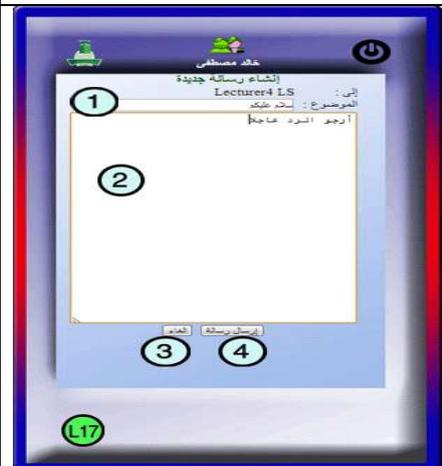
L15- This page has a list of students' reports
 1-Lecturers can view their students' records in this lecture
 2-Percentage of student interactivity in this lecture
 3-Name of students in this report.
 4-Lecturers can search about particular students
 5-Lecturer can go back, it navigates to page LM.

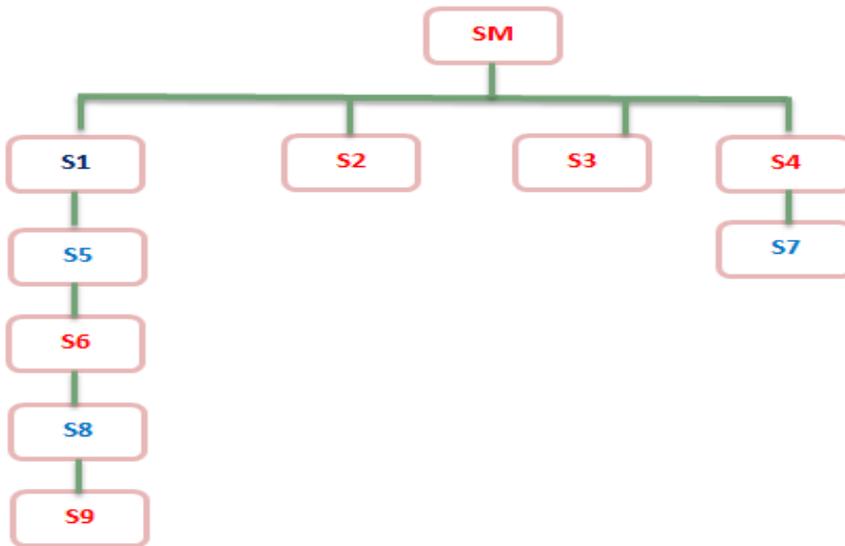


L16- This page is a student report
 1-It indicates a student's name
 2- It indicates the student's interactivity percentage in some lectures.
 3- It indicates correct answers
 4- It indicates incorrect answers
 5-It indicates unmarked answers
 6-Lecturers can go back, it navigates to page LM.



L17- This page is to create a new message
 1-Lecturers can enter the subject for a new message
 2-Lecturers can write a message in this box
 3-Lecturers can send a message. it navigates to L4
 4-Lecturers can cancel sending, it navigates to page L4





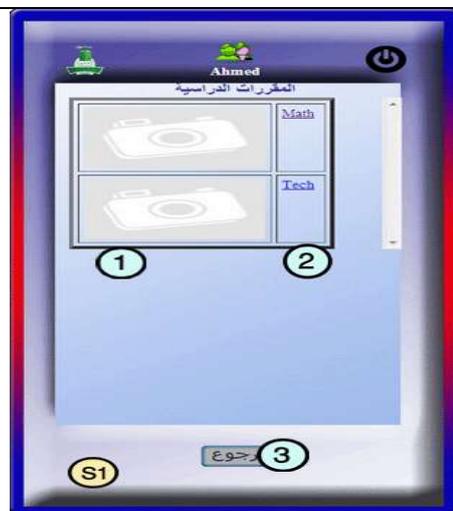
SM: This is the home page for the students in the IELS.

- 1-Students can view their modules, it navigates to S1.
- 2-Students can manage their personal settings, it navigates to S2.
- 3-Students can view their credit, it navigates to S3
- 4-Students can manage their mail messages box it navigates to S4.



S1: This is a list of modules for students in the IELS.

- 1- It indicates the module icon
- 2-It indicates the module name, it navigates to S5.
- 3-Students can go back to the main page, it navigates to SM.

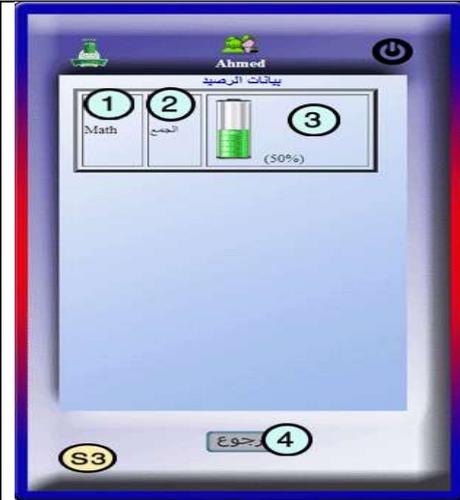


L2- This page is for students' personal settings.

- 1-Students can edit their first name.
- 2-Students can edit their last name.
- 3-Students can edit their email address.
- 4-Students can edit their password.
- 5-Students can confirm their password.
- 6-Students can save amended settings.
- 7-Students can cancel, it navigates to LM.
- 8-Students can go back, it navigates to page SM.



S1: This is a list of credits for students in the IELTS.
 1-It indicates the module name
 2-It indicates the lecture name
 3-It indicates student's interactivity percentage in some lectures
 4-Students can go back, it navigates to page SM.



S4: This page is a list of students' inbox messages
 1-Students can send a new message, it navigates to page S7
 2-Students can manage outbox messages.
 3- Students can delete marked messages.
 4- List of Inbox messages
 5-Students can go back to the main page, it navigates to SM.



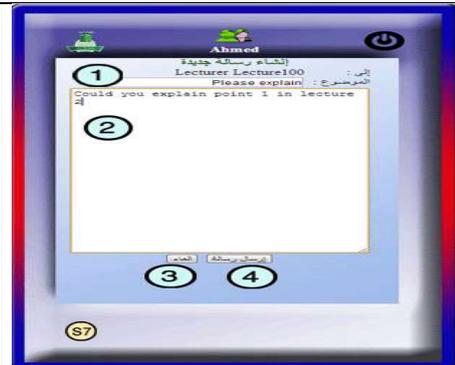
S5: This page is a list of lectures
 1-It indicates the lecture icon
 2-It indicates the lecture name, it navigates to S6
 3-Students can go back to the main page, it navigates to SM.



S5: This page is a list of clips in some lectures
 1-It indicates the student's interactivity percentage in some lectures
 2-Student can identify the lecturer of this lecture and send message directly.
 3-It indicates the clip name, it navigates to S8
 4-Students can go back to the main page, it navigates to SM.



S7: This page is to create a new message
 1-Students can enter the subject for a new message
 2-Students can write a message in this box
 3-Students can send a message. it navigates to S4
 4-Students can cancel sending, it navigates to page S4



S8: This page is to view the interactive clips for students
 1-It indicates clips
 2-It indicates the popup question, student clicks Yes/No
 3-Students can chat with their lecturer or with each other, it navigates to S9
 4-Students can go back to the main page, it navigates to SM.



S9: This page is a chat room
 1-Students can write feedback or ask or answer a question
 2-Students can post their response to their lecturer
 3-List of chat between users in the same lecture
 4-Students can go back, it navigates to page SM.



Action Scenarios

Lecturers have responsibility for the setup of actions. They can choose the type of action and make it according to the lecture topic. For example the IT lecture is about Transmission Media. This lecture was recorded then divided into five video clips (Video clip 1- Video clip 5) according to the main topics in the lecture.

For example video clip1 includes three actions

- **Click Action**

- 1- Upload the video clip
- 2- Specify type of action (Click /Popup)
- 3- Assign Click action to a specific time during the clip
 - 1- Question 1 Click Button will appear randomly (between 0.40 and 1.15)

Transmission Media is a physical pathway that connects computers or devices to a network. (Click on this button when you hear the lecturer define Transmission Media)

- 2- Question 2 Click Button will appear randomly (between 2.15 and 2.30)

Transmission Media is divided into guided wire and unguided wire.

- 3- Question 3 Click Button will appear randomly (between 4.10 and 4.40)

Twisted Pair as a transmission media is classified as a kind of guided wire

- 4- Assign video clip to the lecture
- 5- Assign lecture to students

Students should click on the button when they hear the lecturer talking about specific information. The system will register their click as a response and as an indication that they are paying attention to the topic and will test their engagement with the lecture content. All clicks will be registered in their record.

- **Popup Action**

- 1- Upload the video clip
- 2- Specify type of action (Popup)
- 3- Assign Popup action to a specific time during the clip
 - 1- Popup Question 1 (Is Transmission Media a physical pathway that connects computers or devices to a network? will appear randomly between 0.40 and 1.15 and require an answer from the student (Yes/No)
 - 2- Popup Question 2 (Is Transmission Media divided into guided wire and unguided wire?) will appear between 2.15 and 2.30 and require an answer from the student (Yes/No)
 - 3- Popup Question 3 (Is Twisted Pair as a transmission media classified as a kind of guided wire?) will appear between 4.10 and 4.40 and require an answer from the student (Yes/No)
- 4- Assign video clip to the lecture
- 5- Assign lecture to students

Students should choose the correct answer when they hear the lecturer talking about particular information. The system will record their answer as a response and as an indication that they are paying attention to the topic and will test their engagement with the lecture content. All answers will be registered in their record.

Appendix E

Codes for creating system database Tables

Table structure for table `lecture`

```
CREATE TABLE IF NOT EXISTS `lecture` (  
  `ID` int(11) NOT NULL AUTO_INCREMENT,  
  `NAME` varchar(50) NOT NULL,  
  `DESCRIPTION` text,  
  `LOGO` blob NOT NULL,  
  `logo_type` varchar(10) DEFAULT NULL,  
  `COURSE_ID` int(11) NOT NULL,  
  `USER_ID` int(11) NOT NULL,  
  `Modify_date` int(11) NOT NULL,  
  `STATUS` tinyint(4) NOT NULL DEFAULT '1',  
  PRIMARY KEY (`ID`)  
) ENGINE=MyISAM DEFAULT CHARSET=utf8 AUTO_INCREMENT=61 ;
```

Table structure for table `Clip`

```
CREATE TABLE IF NOT EXISTS `Clip` (  
  `ID` int(11) NOT NULL AUTO_INCREMENT,  
  `CLIP_ID` int(11) NOT NULL,  
  `NAME` varchar(50) NOT NULL,  
  `USER_ID` int(11) NOT NULL,
```

`VIEWS` int(11) NOT NULL,

`MAX` int(11) NOT NULL,

PRIMARY KEY (`ID`)

) ENGINE=MyISAM DEFAULT CHARSET=latin1 AUTO_INCREMENT=153 ;

Table structure for table `action`

CREATE TABLE IF NOT EXISTS `action` (

`ID` int(11) NOT NULL AUTO_INCREMENT,

`USER_ID` int(11) NOT NULL,

`CLIP_ID` int(11) NOT NULL,

`NOTE` varchar(255) DEFAULT NULL,

`S_TIME` int(11) NOT NULL,

`E_TIME` int(11) NOT NULL,

`TYPE` tinyint(4) NOT NULL,

`answer` tinyint(4) NOT NULL,

PRIMARY KEY (`ID`)

) ENGINE=MyISAM DEFAULT CHARSET=utf8 AUTO_INCREMENT=230 ;

Table structure for table `student_score`

CREATE TABLE IF NOT EXISTS `student_score` (

`ID` int(11) NOT NULL AUTO_INCREMENT,

`USER_ID` int(11) NOT NULL,

`LECTURE_ID` int(11) NOT NULL,

`CLIP_ID` int(11) NOT NULL,

`ACTION_ID` int(11) NOT NULL,

```
`POINT` int(11) NOT NULL,  
  
`TIME` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE  
CURRENT_TIMESTAMP,  
  
PRIMARY KEY (`ID`)  
  
) ENGINE=MyISAM DEFAULT CHARSET=utf8 AUTO_INCREMENT=554 ;
```

Table structure for table `user`

```
CREATE TABLE IF NOT EXISTS `user` (  
  
  `ID` int(11) NOT NULL AUTO_INCREMENT,  
  
  `EMAIL` varchar(255) NOT NULL,  
  
  `PASSWORD` varchar(100) NOT NULL,  
  
  `FIRST_NAME` varchar(50) NOT NULL,  
  
  `LAST_NAME` varchar(50) NOT NULL,  
  
  `IMAGE_URL` varchar(333) DEFAULT 'profile/no_image.jpg',  
  
  `IDNUMBER` varchar(255) NOT NULL,  
  
  `PROFILE_LANG` varchar(10) NOT NULL,  
  
  `ACTIVE` varchar(50) NOT NULL,  
  
  `RESET_ACTIVE_NUM` int(11) DEFAULT NULL,  
  
  `Enabled` tinyint(4) NOT NULL,  
  
  `GROUP_ID` int(11) NOT NULL,  
  
  `PERMISSION_ID` tinyint(4) NOT NULL,  
  
  `PERMISSION_panding` tinyint(4) NOT NULL,  
  
  `lecturer` tinyint(4) NOT NULL,  
  
  `online` int(5) NOT NULL,
```

`Modify_date` int(11) DEFAULT NULL,

`Create_date` int(11) DEFAULT NULL,

PRIMARY KEY (`ID`)

) ENGINE=MyISAM DEFAULT CHARSET=utf8 AUTO_INCREMENT=97 ;

Code for Action

```
form action="" method="post">
<script>
function confirmDelete(delUrl) {
    if (confirm("<?=$this->lang->line('delete_message');?>")) {
        document.location = delUrl;
    }
}
</script>
<?php echo validation_errors();?>
<div style="overflow-y: scroll;overflow-x: hidden;max-height:320px;max-width:330px;">
<table width="330">
<?
if(isset($actions)){
foreach ($actions as $action){ ?>
<tr valign="top">
<td><?php
$time=$action->E_TIME;
$e_min=floor($action->E_TIME/60);
$e_sec=$action->E_TIME-($e_min*60);
echo $e_min . ':' . $e_sec;
?></td>
<td><?php
$time=$action->S_TIME;
$s_min=floor($action->S_TIME/60);
$s_sec=$action->S_TIME-($s_min*60);
echo $s_min . ':' . $s_sec;
?></td>
<td>
```

```
<div style="max-width:100px;">
<?=$action->NOTE ;?>
</div>
</td>
<td>
<a href="javascript:confirmDelete('<?=$base_url("clips/delete_action".'/$action->ID.'?url='.uri_string());?>')">
<?=$this->lang->line('delete') ;?>
</a></td>
</tr>
<? }
?>
</table></div>
<? }if(!isset($actions) || count($actions)<num_actions){?>
<table width="350">
<tr>
<td dir="rtl" align="center" width="150">
<?=$this->lang->line('e_time');?><br />
<?=$this->lang->line('second');?> <select name="e_sec" id="e_sec">
<?php
for($i=0; $i<=60; $i++){
echo "<option value=" . $i . """;
echo ">" . $i . "</option>";
}
?>
</select>
: <?=$this->lang->line('minute');?> <select name="e_min" id="e_min">
<?php
for($i=0; $i<=60; $i++){
echo "<option value=" . $i . """;
```

```
echo ">".$i."</option>";
}
?>
</select>
</td>
<td width="150" dir="rtl" align="center">
<?=$this->lang->line('s_time');?><br />
<?=$this->lang->line('second');?> <select name="s_sec" id="s_sec">
<?php
for($i=0; $i<=60; $i++){
echo "<option value=" . $i . """;
echo ">".$i."</option>";
}
?>
</select>
: <?=$this->lang->line('minute');?> <select name="s_min" id="s_min">
<?php
for($i=0; $i<=60; $i++){
echo "<option value=" . $i . """;
echo ">".$i."</option>"; }
?>
</select>
</td>
</tr>
<tr>
<td colspan="2">
<?php
$clip=$this->clips_model->Get_clip_details($this->uri->segment(3));
if($clip->ACTION_TYPE==1){
```

```
?>
<?=$this->lang->line('note');?>
  <? }else{ ?>
    <?=$this->lang->line('click_note');?>
  <? } ?>
<input type="text" id="note" name="note" size="40"/>
</td>
</tr>
<? if($clip->ACTION_TYPE==1){?>
  <tr>
  <td colspan="2">
    <?=$this->lang->line('answer');?> <br /> <select name="answer" id="answer">
    <option value="0">No</option>
    <option value="1">Yes</option>
  </select>
  </td>
</tr>
<? } ?>
<tr>
  <td>
    <div align="right"><br />
    <input name="Submit" type="submit" value="حفظ" />
  </div>
  </td>
</tr>
<? } ?>
</table>
</form>
```

References

- Adjibolosoo, S. (1995). *The Human Factor in Developing Africa*. Greenwood Publishing Group.
- Ahmad, M. (2008). *Comprehensive dictionary of education*. New Delhi: Atlantic Publishers & Distributors.
- Al-Harbi, K. (2011). e-Learning in the Saudi tertiary education: Potential and challenges. *Applied Computing and Informatics*, 9(1), pp.31-46.
- Al-Khalifa, H. (2012). WCAG 2.0 Semi-automatic Accessibility Evaluation System: Design and Implementation. *Computer and Information Science*, 5(6).
- Astleitner, H. and Koller, M. (2006). Approach on Motivation and Student's Learning. *Interactive Educational Multimedia*, (13), pp.11--23.
- Babbie, E. and Babbie, E. (1999). *The basics of social research*. Belmont, Calif.: Wadsworth Pub.
- Baecker, R., Grudin, J., Buxton, W. and Greenberg, S. (1995). A historical and intellectual perspective. *Readings in Human-Computer Interaction: Toward the Year 2000*, pp.35--47.
- Baer, J., Kaufman, J. and Baumeister, R. (2008). *Are we free?*. Oxford: Oxford University Press.
- Baldoni, J. (2005). *Great motivation secrets of great leaders*. New York: McGraw-Hill.
- Barbour, M. and Reeves, T. (2009). The reality of virtual schools: A review of the literature. *Computers & Education*, 52(2), pp.402-416.
- Barthelmess, P., Kaiser, E., Lunsford, R., McGee, D., Cohen, P. and Oviatt, S. (2006). Human-centered collaborative interaction. pp.1--8.
- Beauchamp, G. and Kennewell, S. (2010). Interactivity in the classroom and its impact on learning. *Computers & Education*, 54(3), pp.759-766.
- Bernard, H. (2011). *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. Rowman Altamira.
- Borg, S. and Alshumaimeri, Y. (2012). University teacher educators's research engagement: Perspectives from Saudi Arabia. *Teaching and Teacher Education*, 28(3), pp.347-356.
- Branch, R. (2009). *Instructional Design: The ADDIE Approach: Proceedings of the Second Sussex Conference, 1977*.
- Brewster, L. and University, C. (2006). *A Quantitative Analysis of the Impact Faculty Involvement in the Development and Assessment of Student-learning Outcomes Has on Student Success*. Capella University.

REFERENCES

- Britain, S. (2004). A review of learning design: concept, specifications and tools. *A report for the JISC E-learning Pedagogy Programme*, 2006.
- Burns, R. (1995). *The adult learner at work*. Chatswood, N.S.W.: Sydney: Business and Professional Publishing.
- Carnell, E., Lodge, C., Wagner, P., Watkins, C. and Whalley, C. (2005). *Learning about learning: resources for supporting effective learning*. Routledge.
- Casanova, D., Moreira, A. and Costa, N. (2011). Technology Enhanced Learning in Higher Education: results from the design of a quality evaluation framework. *Procedia - Social and Behavioral Sciences*, 29, pp.893-902.
- Chin, W. and Lee, M. (2000). A proposed model and measurement instrument for the formation of IS satisfaction: the case of end-user computing satisfaction. pp.553--563.
- Chittaro, L. and Ranon, R. (2007). Web3D technologies in learning, education and training: Motivations, issues, opportunities. *Computers & Education*, 49(1), pp.3--18.
- Clark, D. (2012). *Design Methodologies: instructional, thinking, agile, system, or x problem*. [online] Nwlink.com. Available at: <http://www.nwlink.com/~donclark/hrd/sat1.html#model> [Accessed 19 Jan. 2014].
- Clarke, A. (2001). *Designing computer-based learning materials*. Gower Publishing, Ltd.
- Condelli, L. and Wrigley, H. (2004). Real World Research: Combining Qualitative and Quantitative Research for Adult ESL. NRDC Second International Conference for Adult Literacy and Numeracy An examination of research to practice initiatives within ESOL literacy.
- Coon, D., Mitterer, J., Talbot, S. and Vanchella, C. (2010). *Introduction to psychology*. Belmont, Calif.: Wadsworth Cengage Learning.
- Cooper, C., Goswami, U. and Sahakian, B. (2009). *Mental Capital and Wellbeing*. British Library London: John Wiley & Sons.
- Courtiat, J., Davarakis, C. and Villemur, T. (2005). *Technology enhanced learning*. New York: Springer.
- Creswell, J. (2013). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. p.SAGE Publications.
- Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, 16(3), pp.297--334.
- Daim, T. (2011). *Technology Assessment: Forecasting Future Adoption of Emerging Technologies*. Berlin: Erich Schmidt Verlag GmbH & Co KG, 2011.
- Darbyshire, P. (2003). *Instructional technologies: Cognitive aspects of online programs*. IGI Global.
- De Vaus, D. (2002). *Surveys in social research*. London: Psychology Press.
- Demetriadis, S. and Pombortsis, A. (2007). E-lectures for flexible learning: A study on their

REFERENCES

- learning efficiency. *Educational Technology & Society*, 10(2), pp.147--157.
- Denscombe, M. (2010). *The Good Research Guide: For Small-Scale Social Research Projects: for Small-scale Social Research Projects*. UK: McGraw-Hill Education.
- Dick, W., Carey, L., & Carey, J. O. (2001). *The Systematic Design of Instruction* (5th ed.). New York: Longman.
- Domagk, S., Schwartz, R. and Plass, J. (2010). Interactivity in multimedia learning: An integrated model. *Computers in Human Behavior*, 26(5), pp.1024-1033.
- Donnelly, R. and McSweeney, F. (2009). *Applied E-Learning and E-Teaching in Higher Education*. Hershey, PA: Information Science Reference IGI Global.
- Draper, S. and Brown, M. (2004). Increasing interactivity in lectures using an electronic voting system. *Journal of computer assisted learning*, 20(2), pp.81--94.
- Drost, E. (2011). Validity and reliability in social science research. *Education Research and Perspectives*, 38(1), p.105.
- Duke, B., Harper, G. and Johnston, M. (2013). Connectivism as a digital age learning theory. *The International HETL Review*, pp.4--13.
- Ehlers, U. and Pawlowski, J. (2006). *Handbook on Quality and Standardisation in E-learning*. Springer Science & Business Media.
- Ferguson, D. (2009). *Development of Technology Education in New Zealand Schools, 1985-2008*. Ministry of Education.
- Field, A. and Hole, G. (2003). *How to Design and Report Experiments*. London: Sage publications Limited.
- Frey, B. and Sutton, J. (2010). A model for developing multimedia learning projects. *Merlot Journal of Online Learning and Teaching*, 6(2), pp.491--507.
- Gardner, H. (2011). *Frames of Mind: The Theory of Multiple Intelligences*. Basic Books.
- Gatian, A. (1994). Is user satisfaction a valid measure of system effectiveness?. *Information & Management*, 26(3 Elsevier), pp.119--131.
- George, J. and Jones, G. (2012). *Understanding and Managing Organizational Behavior*. Pearson Education.
- Gilbert, J., Morton, S. and Rowley, J. (2007). e-Learning: The student experience. *Br J Educ Technol*, 38(4), pp.560-573.
- Goddard, W. and Melville, S. (2004). *Research methodology: An Introduction*. Juta and Company Ltd.
- Goodman, P. (2001). *Technology Enhanced Learning: Opportunities for Change*. Routledge.
- Gravetter, F. and Forzano, L. (2011). *Research methods for the Behavioral Sciences*. Cengage Learning.
- Gustavsen, P. and Tilley, E. (2003). Public relations communication through corporate

REFERENCES

- websites: Towards an understanding of the role of interactivity. *PRism*, 1(1).
- Hadjerrouit, S. (2007). Applying a system development approach to translate educational requirements into e-learning. *Interdisciplinary Journal of E-Learning and Learning Objects*, 3(1), pp.107--134.
- Haegeman, K., Marinelli, E., Scapolo, F., Ricci, A. and Sokolov, A. (2013). Quantitative and qualitative approaches in Future-oriented Technology Analysis (FTA): From combination to integration?. *Technological Forecasting and Social Change*, 80(3), pp.386-397.
- Haesen, M., Meskens, J., Luyten, K. and Coninx, K. (2010). Draw me a storyboard: incorporating principles & techniques of comics... pp.133--142.
- Hamad, O. (2011). *Analog, Digital and Multimedia Telecommunications: Basic and Classic Principles*. Xlibris Corporation.
- Hamidi, F., Meshkat, M., Rezaee, M. and Jafari, M. (2011). Information technology in education. *Procedia Computer Science*, 3, pp.369--373.
- Harper, R. (2008). *Being human: Human-Computer Interaction in the Year 2020*. Microsoft Research Limited.
- Harre • , R. (2006). *Key thinkers in psychology*. London: SAGE.
- Harvey, L. (2004). [online] Analytic Quality Glossary, Quality Research International. Available at: <http://www.qualityresearchinternational.com/glossary/preliminarystudy.htm> [Accessed 9 Feb. 2015].
- Helm, J. and Katz, L. (2011). *Young investigators: The Project Approach in the Early Years*. Teachers College Press.
- Higher Education, M. (2014). *Higher Education Government and Private Universities*. [online] Available at: <http://www.mohe.gov.sa/en/studyinside/Government-Universities/Pages/default.aspx> [Accessed 11 Nov. 2014].
- Hodges, B. (2011). *Assessment and Planning in Health Programs*. Jones & Bartlett Learning.
- Hollender, N., Hofmann, C., Deneke, M. and Schmitz, B. (2010). Integrating cognitive load theory and concepts of human-computer interaction. *Computers in Human Behavior*, 26(6), pp.1278-1288.
- Howe, M. (1976). *Learning in infants and young children*. Stanford, Calif.: Stanford University Press.
- Huitt, W. (2001). Motivation to learn: An overview. *Educational Psychology Interactive*.
- Hunter, B. (2006). The Espaces study: designing, developing and managing learning spaces for effective learning. *New Review of Academic Librarianship*, 12(2), pp.61--81.
- Interactional Context for Mobile Applications. (n.d.). .
- ISO, O. (2008). *Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with*

REFERENCES

- disabilities*. [online] Iso.org. Available at: <https://www.iso.org/obp/ui/#iso:std:iso:tr:22411:ed-1:v1:en> [Accessed 21 Dec. 2014].
- ISO, O. (2008). *Ergonomics of human-system interaction – Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services*. [online] Iso.org. Available at: <https://www.iso.org/obp/ui/#iso:std:iso:9241:-20:ed-1:v1:en:term:3.7> [Accessed 16 Dec. 2014].
- ISO, O. (2011). *Ergonomics – General approach, principles and concepts. Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities*. [online] Iso.org. Available at: <https://www.iso.org/obp/ui/#iso:std:iso:tr:22411:ed-1:v1:en> [Accessed 3 Jan. 2015].
- ISO, O. (2014). *Quality management - Customer satisfaction -Guidelines for monitoring and measuring*. [online] Iso.org. Available at: <https://www.iso.org/obp/ui/#iso:std:iso:10002:ed-2:v1:en> [Accessed 16 Dec. 2014].
- Jackson, S. (2012). *Research methods and statistics*. Singapore: Wadsworth Cengage Learning.
- Jackson, S. (2015). *Research Methods and Statistics: A Critical Thinking Approach*. Cengage Learning.
- Jadin, T., Gruber, A. and Batinic, B. (2009). Learning with E-lectures: The Meaning of Learning Strategies. *Educational Technology & Society*, 12(3), pp.282--288.
- Jew, A. (2013). *Professional Storyboarding: Rules of Thumb*. UK: Taylor & Francis.
- Johnes, G. and Johnes, J. (2004). *International handbook on the economics of education*. Cheltenham, UK: Edward Elgar.
- Kamrani, A. and Nasr, E. (2008). *Collaborative Engineering: Theory and Practice*. Springer.
- Kappel, G., Pröll, B., Reich, S. and Retschitzegger, W. (2006). *Web engineering*.
- KAU, K. (2010). *King Abdulaziz University Vision and Mission*. [online] Kau.edu.sa. Available at: <http://www.kau.edu.sa/Pages-Our-History.aspx> [Accessed 23 May 2013].
- Kimberlin, C. and Winterstein, A. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health-System Pharmacy*, 65(23), pp.2276-2284.
- Kincheloe, J. and Horn, R. (2007). *The Praeger handbook of education and psychology*. Westport, Conn.: Praeger.
- Klemm, W. (2005). Interactive E-learning-Why Can't We Get Beyond Bulletin Boards?. *Educational Technology & Society*, 8(3), pp.1--5.
- Kolb, A. (2005). The Kolb learning style inventory--version 3.1 2005 technical specifications. Boston, MA: Hay Resource Direct, 200.
- Korakakis, G., Pavlatou, E., Palyvos, J. and Spyrellis, N. (2009). 3D visualization types in multimedia applications for science learning: A case study for 8th grade students in

- Greece. *Computers & Education*, 52(2), pp.390--401.
- Kordaki, M., Papadakis, S. and Hadzilacos, T. (2007). Learning Design: the views of prospective computer professionals. pp.2--11.
- Krishnamurthi, M. (2012). *Instructional Guide for University Faculty and Teaching Assistants*. [online] Niu.edu. Available at: <http://niu.edu/facdev/resources/guide/> [Accessed 14 Oct. 2014].
- Kruse, K. (2002). Introduction to instructional design and the ADDIE model. Retrieved January, 26, p.2005.
- Kwan, R. (2011). *Enhancing learning through technology*. Heidelberg: Springer-Verlag GmbH Berlin Heidelberg.
- Kwan, R., McNaught, C., Tsang, P., Wang, F. and Li, K. (2011). *Enhancing Learning Through Technology: International Conference, ICT 2011, Hong Kong, July 11-13, 2011. Proceedings*.
- Lantos, G. (2010). *Consumer Behavior in Action: Real-life Applications for Marketing Managers*. Armonk, N.Y : M.E. Sharpe.
- Lasswell, H. (1948). The structure and function of communication in society. *The communication of ideas*, 37, pp.215--228.
- Lazar, J., Feng, J. and Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction*. John Wiley & Sons.
- Leonard, D. (2002). *Learning Theories, A to Z*. Greenwood Publishing Group.
- Li, Q. (2013). A novel Likert scale based on fuzzy sets theory. *Expert Systems with Applications*, 40(5), pp.1609--1618.
- Liu, S., Fang, Z., Shi, H. and Guo, B. (2009). *Theory of Science and Technology Transfer and Applications*. CRC Press.
- Lo, S. and Lie, T. (2008). Selection of communication technologies—A perspective based on information richness theory and trust. *Technovation*, 28(3), pp.146-153.
- Maguire, M. and Bevan, N. (2002). User requirements analysis. *Springer*, pp.133--148.
- Manna, D. and Smith, A. (2004). Exploring the need for emotional intelligence and awareness among sales representatives. *Marketing Intelligence & Planning*, 22(1), pp.66--83.
- Martinez-Normand, L. and Pluke, M. (2014). A Decision-Tree Approach for the Applicability of the Accessibility Standard EN 301 549. *Springer*, pp.295--302.
- McConnell, J. and Philipchalk, R. (1992). *Understanding human behavior*. Fort Worth: Harcourt Brace Jovanovich College Publishers.
- McMinn, M. (2012). Lecturing for Success: Integration of E-Lectures in the High School History Setting.
- Miller, A. (2004). *Mentoring Students and Young People: A Handbook of Effective Practice*.

REFERENCES

- Routledge.
- Morreale, S., Spitzberg, B. and Barge, J. (2007). *Human communication: Motivation, knowledge, and skills*. Belmont, USA: Cengage Learning.
- Mortimore, T. (2003). *Dyslexia and learning style*. London: Whurr.
- Muirhead, B. (2000). Interactivity in a graduate distance education school. *Educational Technology & Society*, 3(1), p.2000.
- Mujtaba, B. and Preziosi, R. (2006). *Adult education in academia*. Greenwich, Conn.: Information Age Pub.
- Murphy, P. and Fogarty, G. (2009). Good to go? The human dimensions of mission readiness. *Focus on Human Performance in Land Operations*, 1, pp.46--55.
- Naidu, S. (2003). *Learning & Teaching with Technology: Principles and Practices*. Psychology Press.
- Nallari, R., Griffith, B., Wang, Y., Andriamananjara, S., Chen, D. and Bhattacharya, R. (2011). *A Primer on Policies for Jobs*. World Bank Publications.
- Neideen, T. and Brasel, K. (2007). Understanding Statistical Tests . *Journal of Surgical Education*, [online] 64(2), pp.93-96. Available at: <http://www.sciencedirect.com/science/article/pii/S1931720407000578>.
- Norman, D. and Nielsen, J. (2010). The way I see it Gestural interfaces. *interactions*, 17(5), p.46.
- Norman, G., Vleuten, C. and Newble, D. (2002). *International Handbook of Research in Medical Education*. Dordrecht: Springer Science & Business Media.
- Novell, (2008). *10 Ways to Enhance Communication and Collaboration in Education*. [online] Novell. Available at: https://www.novell.com/docrep/2008/06/10_Ways_to_Enhance_Communication_and_Collaboration_in_Education_en.pdf [Accessed 15 Nov. 2014].
- Nunnally, J. (1978). C. (1978). *Psychometric theory*. New York: McGraw-Hill.
- O'Donnell, A., Reeve, J. and Smith, J. (2011). *Educational Psychology: Reflection for Action*. John Wiley & Sons.
- O'Farrell, C. (2002). Enhancing student learning through assessment. *Dublin: Institute of Technology*.
- Oliver, P. (2010). *The student's guide to research ethics*. UK, Glasgow: McGraw-Hill International.
- Ormrod, J. (2011). *Human Learning*. Pearson.
- Other publications. Mentoring Students and Young People: a Handbook of Effective Practice. (2002). *Education + Training*, 44(7).
- Ottenbreit-Leftwich, A., Brush, T., Strycker, J., Gronseth, S., Roman, T., Abaci, S., Shin, S.,

REFERENCES

- Easterling, W. and Plucker, J. (2012). Preparation versus practice: How do teacher education programs and practicing teachers align in their use of technology to support teaching and learning?. *Computers & Education*, 59(2), pp.399--411.
- Oxforddictionaries.com, (2014). *Oxford Dictionaries*. [online] Available at: <http://www.oxforddictionaries.com/> [Accessed 24 Nov. 2015].
- Park, J. (2008). iLED: interactive learning experience design. *Journal of Online Learning and Teaching*, 4(3), pp.357--370.
- Partnership with 21st Century, (2009). *21st Century Learning Environments*. [online] P21.org. Available at: <http://www.p21.org/> [Accessed 24 Oct. 2014].
- Payne, C. (2009). *Information Technology and Constructivism in Higher Education: Progressive Learning Frameworks: Progressive Learning Frameworks*. Information Science Reference.
- Pritchard, A. (2013). *Ways of Learning: Learning Theories and Learning Styles in the Classroom*. Routledge.
- Rafaeli, S. and Sudweeks, F. (1997). Networked interactivity. *Journal of Computer-Mediated Communication*, 2(4), pp.0--0.
- Ramsey, P. and Legg, S. (2006). Readiness to Learn. *The Journal*, 67.
- Razali, N. and Wah, Y. (2011). Power comparisons of shapiro-wilk, kolmogorov-smirnov, lilliefors and anderson-darling tests. *Journal of Statistical Modeling and Analytics*, 2(1), pp.21--33.
- Ringstaff, C. and Kelley, L. (2002). The learning return on our educational technology investment. Retrieved April, 15, p.2009.
- Robson, C. (1994). *Experiment, Design and Statistics in Psychology*. Penguin Books, Limited, pp.112-123.
- Rogers, P. (2002). *Designing instruction for technology-enhanced learning*. Hershey, PA: Idea Group.
- Royal, C. and Education, C. (2007). *Exploring the Use of Instructional Design Models for Web-based Instruction in Higher Education: A Modified Delphi Study*. Capella University.
- Rubin, A. (2009). *Statistics for Evidence-Based Practice and Evaluation*. Canada: Cengage Learning.
- Ryan, K. and Cooper, J. (2012). *Those Who Can, Teach*. Cengage Learning.
- Sadri, H. and Flammia, M. (2011). *Intercultural Communication: A New Approach to International Relations and Global Challenges*. A&C Black.
- Salkind, N. (2004). *An Introduction to Theories of Human Development*. Thousand Oaks, Calif.: Sage Publications.
- Savoy, A., Proctor, R. and Salvendy, G. (2009). Information retention from PowerPoint, and traditional lectures. *Computers & Education*, 52(4), pp.858-867.

REFERENCES

- Sax, G. and Newton, J. (2010). *Principles of Educational and Psychological Measurement and Evaluation*. Wadsworth.
- Schank, R. (1995). What we learn when we learn by doing. *Northwestern University*.
- Schmidt, A. (2000). Implicit human computer interaction through context. *Personal Technologies*, 4(2-3), pp.191-199.
- Schroter, D. (2010). Sustainability evaluation checklist. *Western Michigan University*.
[online] Available at:
<http://usaidprojectstarter.org/sites/default/files/resources/pdfs/SEC-revised.pdf>
[Accessed 6 Jan. 2013].
- Schunk, D. (2012). *Learning theories*. Boston: Pearson.
- Seels, B. (1995). *Instructional design fundamentals: A reconsideration*. Educational Technology.
- Selander, S. (2008). Designs for learning: a theoretical perspective. *Designs for learning*, 1(1), pp.10--23.
- Servaes, J. (2008). *Communication for development and social change*. SAGE Publications India, pp.20,21.
- Shank, P. (2005). The value of multimedia in learning. *Adobe Motion Design Center*.
- Shannon, C. and Weaver, W. (1959). *The mathematical theory of communication*. University of Illinois Press.
- Sharpe, R. and Benfield, G. (2005). The student experience of e-learning in higher education. *Brookes eJournal of Learning and Teaching*, 1(3).
- Sheskin, D. (2003). *Handbook of Parametric and Nonparametric Statistical Procedures: Third Edition*. CRC Press.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International journal of instructional technology and distance learning*, 2(1), pp.3--10.
- Stein, F. and Cutler, S. (2002). *Psychosocial Occupational Therapy: A Holistic Approach*. Delmar/Thomson Learning.
- Steinberg, S. (1995). *Introduction to Communication Course Book 1: The Basics*. Juta and Company Ltd.
- Steinmetz, R. and Nahrstedt, K. (2004). *Multimedia applications*. Berlin: Springer.
- Szekely, P. (1995). User interface prototyping: Tools and techniques. Paris: Springer, pp.76--92.
- Taylor, E. (2008). Transformative learning theory. *New Directions for Adult and Continuing Education*, 2008(119), pp.5-15.
- Taylor, G. (2005). *Integrating quantitative and qualitative methods in research*. University Press of America.

REFERENCES

- Turnock, C., Gannon-Leary, P., McCarthy, M. and Gannon, P. (2007). Interactive Lectures: Staff and Student Views on their use. p.477.
- van Merriënboer, J. and de Bruin, A. (2014). Research paradigms and perspectives on learning. *Springer*, pp.21--29.
- Vegas, E. and Umansky, I. (2005). Improving teaching and learning through effective incentives: What can we learn from education reforms in Latin America?. *Washington, DC*.
- Wang, Y. (2011). *Education and Educational Technology*. Springer Science & Business Media.
- Weber, M., Chandler, J. and Finley, D. (2011). Assessing Teaching Effectiveness in a Basic Food Laboratory Setting: Pilot Testing the Instrument. *Journal of Teaching in Travel & Tourism*, 11(2), pp.211--225.
- Wheeler, D. (2008). *The academic chair's handbook*. San Francisco: Jossey-Bass.
- Winter, J., Cotton, D., Gavin, J. and Yorke, J. (2010). Effective e-learning? Multi-tasking, distractions and boundary management by graduate students in an online environment. *Research in Learning Technology*, 18(1).
- World Wide Web Consortium Recommendation, W. (2014). .
- Yacci, M. (2000). Interactivity demystified: A structural definition for distance education and intelligent CBT. *Educational Technology*, 40(4), pp.5--16.