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PHD THESIS

RESEARCH TITLE:

A Model for Evaluating E-learning Systems Quality. A case of Jomo Kenyatta University of Agriculture & Technology

RESEARCHER: KENNEDY OCHILO HADULLO
AD No: P80/98627/2015

SUPERVISORS: Prof. ROBERT OBOKO
Prof. ELIJAH OMWENGA

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Submitted in partial fulfillment of the requirements of the Doctor Philosophy (PhD) in Information Systems of the University of Nairobi.

Declaration

I hereby declare that this project is my own work and has to the best of my knowledge not been submitted to any other institution of higher learning.

Student: Kennedy Ochilo Hadullo Registration Number P80/98627/2015

Signature…… Date: ……

This thesis has been submitted as a partial fulfilment of requirements for the PhD in Information Systems of the University of Nairobi with my approval as the University supervisor.

Supervisor: Prof. Robert Oboko

Signature: …… Date……

Supervisor: Prof. Elijah Omwenga

Signature: …… Date…….

Dedication

To my spouse Claire and son Daniel.

List of Abbreviations & Acronyms

1) AMOS – Analysis of Moment Structures
2) AVE – Average Variance Extracted
3) CAT-Continuous Assessment Test
4) CFA – Confirmatory Factor Analysis
5) CFI – Comparative Fit Index
6) CR – Construct Reliability
7) CRL- Context Relevant Literature
8) CR-Composite Ratio
9) DF-Degree of Freedom
10) ELS-E-learning System
11) EMM- E-Learning Maturity Model
12) EQF-E-learning Quality Framework
13) ECU-Edith Cowan University
14) GOK – Government of Kenya
15) HEIs-Higher Educational Institutions
16) ICT – Information and Communication Technology
17) IS – Information System
18) ISDT-Information System Design Theory
19) IRRODL- International Review of Research in Open and Distributed Learning
20) IJEDE-International Journal of E-Learning & Distance Education
21) EJEL-Electronic Journal of e-Learning
22) JKUAT-Jomo Kenyatta University of Agriculture & Technology
23) LMS-Learning Management System
24) MOODLE-Modular Object-Oriented Dynamic Learning Environment
25) IS-Information System
26) IT – Information Technology
27) MI-Modification Indices
28) MBA-Masters in Business Administration
29) NFI – Normal Fit Index
30) NQDAS-NVivo qualitative data analysis software

31) OECD-Organization for Economic Co-operation and Development

32) PA – Path Analysis

33) PCs – Personal Computers

34) PDF-Portable Document Format

35) PhD – Doctor of Philosophy

36) P3-People, Processes & Products

37) PDPP-Planning, Development, Process, and Product evaluation

38) PLS-Partial Least Squares.

39) RMSEA – Root Mean Squared Error of Approximation

40) ROI – Return on Investment

41) SEM – Structure Equation Modeling

42) SCI-School of Computing and Informatics

43) SPSS – Statistical Package for the Social Sciences

44) SR – Structural Relations

45) SODEL-School of Open Distance Education and Learning

46) TLA-Teaching and Learning Activities

47) TMLE-Technology Mediated Learning Evaluation

48) UNESCO-United Nation's Educational and Cultural Organization

49) USAID-United States Agency for International Development

Definitions of Terms

Affirmation Support: the act of giving a positive feedback about the person's behaviours and decisions how they bolstered each other's morale and shared experiences in the discussion forums or working on small group assignments and collaborating in the large group discussions.

Average Variance Extracted: AVE indicates the average percentage of variation explained by the measuring items for a latent construct

Attrition refers to a decrease in the number of students participating in course activities or a degree program.

Asynchronous E-learning: is learning that is administered at the learners pace enabling them to download learning materials, do assignments and interact with their peers at their own time.

Blended Learning: is learning that allows students to receive significant portions of instruction through both face-to-face and online means.

Biggs Constructive Course Design Framework for Quality Learning also known as Biggs Framework of Constructive Alignment or Biggs Framework of Quality Education.

Collaborative Learning: learning activities ranging from discussions and knowledge sharing to working together on a common project.

Course Design: the process of formulating a set of learning objectives, selecting instructional, media, evaluation and delivery strategies.

Course Development: the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction.

Content Support: the support given to the learners in teaching and learning online courses through techniques such as announcement and reminders, use of multimedia, authentic content and frequent feedbacks.

Computer Self-Efficacy: means individuals self-assessment of their ability to apply computer skills to accomplish their tasks

Composite Reliability: estimates the extent to which a set of latent construct indicators share in their measurement of a construct.

Construct Reliability: measures the extent to which indicators of a latent construct are internally consistent in their measurement and that the indicators measure the true value and are error free.

Construct Validity: the degree to which a test measures what it claims, or purports, to be measuring. This validity is achieved when the Fitness Indexes for a construct achieved the required level.

Convergent Validity: Validity achieved when all items in a measurement model are statistically significant.

Content Support: any interactive activities and services intended to support and facilitate the learning process such as use of multimedia, discussion forums and LMS group chat.

Correlation: a statistical technique that can show whether and how strongly pairs of variables are related.

C**ovariance:** a measure of the joint variability of two random variables, which can be either positive or negative.

Curriculum: means any documented programme of study.

Degree of Freedom: The number of values in the final calculation of a statistic that are free to vary. The number of independent ways by which a dynamic system can move without violating any constraint.

Discriminant Validity: indicates the measurement model of a construct is free from redundant items.

Distance Education means delivery of learning or training to those who are separated mostly by time and space from those who are teaching or training.

Emotional Support: the act of showing concern or compassion, either online from their peers or off line from their families.

E-learning: is frequently used to refer to distance learning (DL), open learning (OL), or open and distance learning and may cover content and instructional methods delivered via CD-ROM, the Internet, or an intranet, audio- and videotape, satellite broadcasts, interactive TV, and mobile devices.

E-learning in the study: refers to web based LMS supported asynchronous and synchronous e-learning.

E-learning Quality Evaluation: is a term that may take on multiple meanings depending on the context within which it is discussed.

Quality in the context of HEIs may be taken to mean cost-effectiveness in education, achievement of educational goals and objectives, learning effectiveness, user satisfaction and learning retention.

Evaluation: is the systematic process of analyzing and determining the worth of a project or programme considering covariates and taking into account the effect of attribution and causality.

Flexible Learning: means provision of learning opportunities that can be accessed at any place and time.

Fully Online Learning: is a form of distance education in which all instruction and assessment are online or Internet-based.

Informational Support: the act of providing advice or information to assist decision-making during an e-learning course in the forum.

Instrumental Support: the act of providing practical help and resources e.g. online library.

Institutional Factors: factors that address technological infrastructure issues, policy, culture and funding.

Instructional Design: is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction.

Institution: means an organization founded for purposes of university education and research.

ICT: is a general term that incorporates use of communication devices or applications that encompass use of radio, television, cellular phones, computers and computer networks.

Learning Management System (LMS): is a software environment that enables the management and delivery of learning content and resources to students.

LMS Supported E-learning: is e learning that primarily uses LMS.

Kurtosis: is any measure of the "peakedness" or “flatness” of the probability distribution of a random variable.

Measurement: is the process by which attributes or indicators of a phenomenon are determined and counted.

Model: is a set of verifiable mathematical relationships or logical procedures that are used to represent observed, measurable real-world phenomena.

Model Parameters: are those characteristics of model unknown to the researcher and estimated from the sample covariance or correlation matrix such as, regression weights/Factor loadings; Structural Coefficient; Variance; Covariance.

Moderator Variable: is a third variable that affects the strength of the relationship between a dependent and independent variable.

Monitoring and Evaluation: involves identifying the goals and key indicators of a programme, execution, management and progress of interventions over time and establishing whether the intended targets have been achieved.

Multimedia Technologies: broadly refer to the development and the use of various types of media and communication technologies to enhance content visualization and user interaction.

Outcome: is perceived as the result of input/output activities regarding the uptake and usage of e-learning mode of study.

Outlier: is an observation point that is distant from other observations. It may be due to variability in the measurement or it may indicate experimental error; the latter are sometimes excluded from the data set.

Online Learning: comprises a wide variety of programs that use the Internet within and beyond institutional walls to provide access to instructional materials as well facilitates interaction among teachers and students.

Open Learning: means policies and practices that permit entry to learning with no or minimum barriers with respect to age, gender, or time constraints and with recognition or prior learning.

Persistence: refers to the act of continuing toward an educational goal such as earning a degree or certificate.

Reliability: is the extent of how reliable is the said measurement model in measuring the intended latent construct.

Retention: is measured by the number of students that progress from one level to next in a degree program until either completion of the degree program or the student's personal goals are met.

Skewness: is a measure of the asymmetry of the probability distribution of a random variable

Social Support: is the combined instrumental support, affirmation support, emotional support, and informational support received from different sources, such as, peers, forum, chat and e-learning group work.

Sub-Saharan Africa*:* is, geographically, the area of the continent of *Africa* that lies south of the Sahara. According to the United Nations, it consists of all *African countries* that are fully or partially located south of the Sahara.

Structural Equation Modeling (SEM): is a multivariate statistical analysis technique that combines factor analysis and multiple regression analysis to analyze structural relationships between measured variables and latent constructs.

Systematic Review: a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review.

Synchronous E-learning: is e-learning that is live and done in real-time by the use of tools such as chat rooms and webcasts.

Uni-dimensionality: is achieved when all measuring items have acceptable factor loadings for the respective latent construct.

Validity: is the ability of instrument to measure what it supposed to measure for a latent construct.

Virtual Education means distance education, which is largely web-cantered, but does not necessarily limit itself to learners outside a conventional classroom.

Virtual Classroom: an e- learning event where an instructor teaches remotely and in real time to a group of learners using a combination of materials (e.g. PowerPoint slides, audio or video materials).

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Abstract

The rapid growth of Information and Communication Technology (ICT) has significant changes in the practice of education globally using Learning Management System (LMS) assisted e-learning in Higher Education Institutions (HEIs). Despite the perceived benefits such as flexible and broad access, e-learning is still facing challenges such as identifying the needs for the students, the instructors and the technicians and providing quality courses. Furthermore, evaluating existing e-learning initiatives and determining critical success factors for quality has been lacking. This has called for further investigation into e-learning practices in order to fill the gaps identified. The study presents a model for evaluating e-learning system quality through modifying and extending the Biggs Framework for Quality Learning with other models and frameworks. A descriptive and exploratory research using a cross-sectional survey of 180 respondents from Jomo Kenyatta University of Agriculture & Technology (JKUAT) was used. Data was collected via QuestionnaireS and Interviews with a stratified sampling technique. The conceptual model was validated using Structural Equation Modeling and Regression Analysis. The study found out that course design, content support, administrative support, user characteristics, institutional factors and social support influence quality. This Research has contributed to the body of knowledge from theoretical, methodological, and practical points of view.

Keywords: E-learning, Biggs Framework, Quality Evaluation Model, Quality Factors, Descriptive, Exploratory, Pre-study, Case study, Cross-Sectional, Survey, Structural Equation Modeling, Regession Analysis, SPSS AMOS.

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CHAPTER ONE-INTRODUCTION

1.1 Introduction and Motivation

E-learning systems (ELSs), which are information systems (ISs), are often associated with human resources and can be seen as strategic tools for organizations. The benefits of introducing ELSs include (a) higher employee satisfaction, (b) better opportunities for career growth and flexible learning for employees, (c) increased innovation, (d) better operational efficiency, and (e) cost savings (Cukusic, Alfirevic, Granic, & Garaca, 2010; Lai & Liou, 2010).

However, while the majority of these benefits are enjoyed by institutions in the developed countries (Paulsen, 2003), most e-learning initiatives in developing countries have not been successful (Shahid, 2005; Borstorff & Keith, 2007; Sife, Lwoga & Sanga, 2008; Zaharias, 2006; Khan et. al, 2010). E-learning initiatives particularly in the Sub Saharan Africa where it is estimated that only 1 in 250 people have access to the Internet as against the global average of 1 in 15 (UNESCO Institute for Statistics, 2007) is still in its infancy and are facing difficulties.

Raspopovic et al. (2014) argues that evaluation of e-learning is both vital for accepting its value and efficiency as well as for its understanding and acceptance. Evaluation is crucial for acceptance by stakeholders and for further development and expansion of e-learning. Various factors have been identified as important in the success of evaluating e-learning systems (Shee & Wang, 2008). Such factors which are considered as influencing the quality of e-learning systems include: student factors, instructor factors, course design factors, course support factors, course assessment factors and institutional factors (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014; Chawinga, 2016; Kisanga, 2016).

1.2 Background

According to the Organization for Economic Co-operation and Development (OECD), many countries are currently overseeing a massive expansion of higher education in order to provide broader access and greater diversity of study programmes to students (OECD, 2014). However,

this expansion has been done at the expense of quality education in some institutions (United States Agency for International Development (USAID), 2014).

Quality which can be defined as 'fitness for purpose' related to the needs of the user (Juran 1988) is considered as a major issue for modern education generally, but particularly so for institutions involved in e-learning (Ajmera & Kumar 2014). Quality can be used as an evaluation of excellence. Secondly, it can be viewed and considered by different aspects so it is important to set standards for quality. In the context of HEIs, Mayes & Freitas (2013) as cited in Biggs (1999;2014) observes that institutions should evaluate their education systems in terms of whether the objectives of the course design, course assessments, teaching methodology, environmental factors and the achievement of institutional goals.

Ehlers (2004) argues that education is not a product but a process and therefore quality of e-learning constitutes a process that must be carried out by the learners and instructors. According to Ehlers, e-learners' quality requirements can be structured into seven fields of quality – tutor support, Cooperation and Communication in the Course, technology, cost-expectation benefits, information transparency of the course, course structure and didactics.

However, improving the quality of education is one of the most significant challenges for HEIs particularly in sub Saharan Africa. This is mainly due to the enrollment expansion characterized by a range of weak inputs such as low quality of instruction, lack of financial resources, weak academic preparation, inadequate teaching staff, poor remuneration and Inadequate staff qualifications (USAID, 2014; Johanson, Richard & Shafiq, 2011; Aung & Khaing, 2016).

Taking into account all the challenges discussed above, it is clear that Higher Education Institutions (HEIs) practicing e-learning still remains behind in the use of using ICTs for its quality and effective training. The study therefore undertook to investigate the gaps that have caused e-learning to lack quality by determining the factors that influence e-learning system use in HEIs and create an evaluation model suitable for HEIs e-learning systems.

1.3 Problem Statement

Despite the initiatives taken by countries, practicing e learning to increase access to higher education and provide a flexible mode of learning, the acceptance, use and implementation is still limited and can be considered as a failure (Ssekakubo et al., 2011). There is general agreement that e-learning quality need to be evaluated at six different stages namely: Planning, Design, development, Instruction, Evaluation, Delivery and Maintenance (Khan, 2004; Zhang & Cheng, 2012; Marshall, 2002). The evaluation of each state however presents problems that need to be tacked.

The first problem in evaluation is experienced at the planning stage. Planning which involves Institutional Managers and E-Learning Experts have issues related to determining critical success factors for quality evaluation (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014Chawinga, 2016; Kisanga, 2016). These factors have not been clearly identified leading to poor quality of e learning.

The second problem has been experienced at the design stage. E-learning course design which involves e-learning Experts, Technicians, Subject Matter Experts and Instructional Designers have issues with identifying students' needs, instructor needs, technicians needs and institutional capabilities that influence quality (Khan, 2004; Zhang & Cheng, 2012; Masoumi & Lindstrom, 2012).

The third problem focusses at how to evaluate the delivery stage of e learning. The study has identified five evaluation factors that need to be clearly defined in the context of institutions practicing e-learning. These were: content support, social support, course assessment, intuitional factors and user characteristics (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014Chawinga, 2016; Kisanga, 2016). According to Salmon (2004), each aspect of content delivery requires different types of support from instructor, technician or institution without which learning may fail to take place.

The fourth problem regards the overall evaluation process of an e-learning system. Evaluation, which involves Technicians, Instructors / Subject Matter Experts, and Evaluation Experts has also

been experiencing problems related to lack of procedures for conducting formative and summative evaluation as well as a comprehensive model that fits the context of HEIs practicing e-learning(Khan, 2004).

In light of the above concerns, it is evident that there is a need to derive a comprehensive e-learning evaluation model by reviewing the existing models and frameworks of e-learning evaluation with the view of obtaining model that can improve the quality and use of e-learning systems for HEIs.

1.4 Research objectives

The following objectives were formulated for the research:

a) To establish the determining and moderating factors for developing an e-learning system quality evaluation model that is suitable for countries practising e learning.

b) To determine the Quality status of JKUAT e-learning system based on the quality factors established in (a).

c) To utilize the quality determinants established in (a) in modifying Biggs Framework of Quality Education and hence create a tool for reviewing the existing e-learning models and frameworks of quality evaluation.

d) To derive a comprehensive e-learning quality evaluation model based on other models and frameworks that is suitable for use in countries practicing e-learning.

e) To validate the model using Structured Equation Modeling (SEM) and Regression Analysis via primary data obtained from JKUAT e-learning postgraduate students.

1.5 Justification of the Study

According to the Ambient Insight report (Adkins, 2013), e-learning is forecast to grow in Africa as a whole at a rate of 15% per annum over the next four years, with growth rates in individual countries at the following rates: Senegal: 30%; Zambia: 28%; Zimbabwe: 25%; Kenya: 25%. The democratization of education and training by e-learning is a major benefit and driver for economic growth (OECD, 2014). For e-learning practitioners, the potential for growth of e-learning in terms of infrastructure and bandwidth provides both opportunities and challenges. With respect to e-learning, for example, there is the opportunity to connect with millions of new

learners. Along with it comes the challenge of developing quality courses, providing learner support and infrastructure such as internet connectivity and computing devices like laptops and tablets.

With such trends in front of them, e-learning providers are increasingly looking to understand and focus on how to provide quality e-learning to enhance the growth of ICT integration into higher education systems. With the development of a model of evaluation, HEIs within these countries will be able to mitigate against e-learning risks by determining gaps in provision of education in advance, thereby ensuring that their online training programmes are worth the investment by trying to enhance quality. Secondly, policy makers, donors and sponsors of e-learning projects will also benefit from the study, as the model once adopted will help in identifying factors necessary for the successful implementation of e-learning in HEIs. Lastly, the study will also benefit e-learning providers by providing valuable insight into the e-learning obstacles that may hinder the quality and use of e-learning. The study provides the opportunity to identify these hurdles and provide remedies to overcome them.

1.6 Scope

The study commenced by determining the factors that affect e-learning system quality for HEIs globally. Next, the factors were used to determine the status of quality of the e-learning system at Jomo Kenyatta University of Agriculture & Technology (JKUAT) followed by the creation of a review tool that was used to review the models and frameworks of evaluation. Finally, the strengths and weaknesses of five models and frameworks of evaluation were determined, after which a comprehensive model of quality evaluation was proposed.

The study then employed a descriptive and exploratory research, 180 respondents from JKUAT, Structural Equation Modeling (SEM) and Regressing Analysis techniques in methodology. Also used were questionnaires and interviews as instruments, as well as students, Statistical Package for the Social Sciences (SPSS) and Analysis of Moment Structures (AMOS) version 21, Microsoft Excel 2013 as well as instructors and technicians as the unit of analysis.

1.7 Assumptions

The assumptions taken during the study were:

i. All the respondents would answer all survey questions honestly and to the best of their abilities.
ii. The results would not be affected by the fact that respondents are pursuing different postgraduate courses like MBA, IT, Entrepreneurship, Project Management and Human Strategic Management.
iii. The data collected will be normally distributed.
iv. Multi-collinearity will not exist between variables of the study.

1.8 Structure of the Thesis

The structure of the thesis was done based on the five chapters of the study. This is summarized in Table 1.

Table 1: Thesis Structure

chapter	Description
Chapter 1	Chapter one introduces the study providing the background and motivation for the research, the research problem, the research objectives as well as the justification and the scope of the study. In addition, the assumptions, the structure of the thesis and the summary of the research process is also provided.
Chapter 2	Chapter two reviews literature by identifying and justifying the key determinants of e-learning quality evaluation. The study then uses the determinants to modify Biggs Framework to obtain a review tool. The review tool is then used to asses five frameworks and models of evaluation so as to identify if they have any gaps before a conceptual framework is presented and hypotheses outlined.
Chapter 3	Chapter three addresses the methodology starting from research philosophy to target population, sample size and data collection instruments. The chapter explains how the data was collected, prepared and analyzed before testing of the hypothesis giving the details of all the tests undertaken.
Chapter 4	Chapter four collates the results and the discussions of the study. Using primary data from JKUAT and deploying SEM and Regression Analysis techniques, a very exhaustive analysis was undertaken to establish the various relationships that make the model. After every output of the analysis, a discussion is presented linking the particular findings from the study to the rest of the study.
Chapter 5	Chapter five amplifies on the contribution to knowledge, conclusions and recommendations. After providing, the concluding remarks based on the study and relating the model, the hypotheses and the objectives to the findings, the researcher makes recommendations on how the study can be deployed by the target group.
Appendices	The appendices contain some of the samples of the ethical and approvals that were needed to permit the carrying out of the research in order to conduct the study in the Kenya education sector. The instruments used to collect data as well as some of the analysis results are also included.

CHAPTER TWO-LITERATURE REVIEW

2.1 Introduction

The literature review begins with the formulation of an Information System Design Theory (ISDT) for the study. This is closely followed by the analysis empirical literature on e-learning systems for HEIs with the view of determining research gaps in e-learning evaluation. The chapter then creates a review tool based on the Biggs Framework of Quality Learning after establishing the factors that determine quality. These factors are used to modify and extend Biggs Framework. The modified framework is then used to review existing models and frameworks of quality. Finally, a comprehensive model suitable for evaluating e learning in HEIs is derived.

2.2 Information Systems Design Theory

The main aim of research in information systems (IS) is the study of the effective design, delivery, use and impact of Information Technology (IT) in organizations and society (Keen, 1987). The study is an example of design research within the information systems field. Design research aims to make use of existing knowledge and theory to construct artefacts that improve some situation (Simon, 1996).

Theories from education, psychology and related fields have been used to provide guidance for the design of certain aspects and applications of e-learning. However, there has been limited theory-based guidance for the design and support of the underlying information systems infrastructure. A theory is needed because the design and implementation of such systems is complex as they incorporate a variety of organizational, administrative, instructional and technological components (Avgeriou et al., 2003).

2.2.1 ISDT for E-learning

The use of an ISDT described in the study leads to an information system that offers a greater variety of features, allows greater flexibility in the choice of applications, greater integration within the HEIs and encourages greater staff and student usage than alternate approaches (Jones & Gregor, 2004). The components of an ISDT and their relationships as identified by Walls et al (2004; 1992) are illustrated in figure 1.

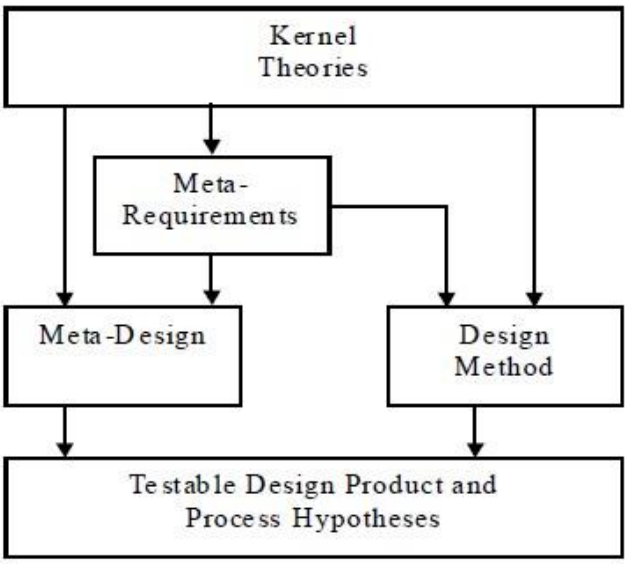

Figure 1: Components of an ISDT (Walls et al., 1992)

According to Markus et al. (2002), ISDTs are an integrated prescription consisting of a particular class of user requirements (Meta requirements), a type of system solution with distinctive features (meta-design) and a set of effective development practices (design method). Each component of an ISDT can be informed by kernel theories that enable the formulation of empirically testable predictions about the outcomes of the design theory.

a) Kernel Theories

Kernel theories provide the foundation knowledge on which other aspects of the ISDT are built. The role played by each kernel theory is provided in table 2.

Table 2: Kernel Theories

ISDT Component	**Kernel Theories**
Meta-requirements	E-learning literature on processes, activities, participants, and technologies.
Meta-Design	Hypermedia templates (Catlin et al., 1991, Nanard et al., 1998) and Design patterns (Fowler, 2003)
Design method	Emergent development (Truex et al., 1999) & Diffusion theory (Rogers, 1995).

According to Catlin et al. (1991) and Nanard et al. (1998), Hypermedia templates are an approach to simplifying the authoring process while still ensuring the application of good information design principles. Experts, with appropriate skills, are responsible for the creation of hypermedia templates. The use of hypermedia templates enables content experts to take responsibility for maintaining the e-learning websites and can thus increase ownership, decrease costs(Jones,1999) and address the authoring problems (Thimbleby,1997). Nanard et al. (1998) added that Hypermedia templates also aid in reuse, which is a strategic tool for reducing the cost and improving the quality of hypermedia design and development.

Another merit is the use of Design Patterns (DP). DPs offer an approach to documenting and supporting the reuse of design, which is finding favour in hypermedia. Gamma et al. (1993) postulated that the use of patterns provides a number of benefits including making it easier to reuse successful designs, make proven techniques more accessible to developers, enable choice between alternatives, and improve the documentation and maintenance of existing systems.

b) Meta-Requirements

Quality e-learning Systems calls for the inclusion of student factors, instructor factors, course design factors, course support factors, course assessment factors and institutional factors (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016). The meta-requirements for the ISDT have been divided into two categories common in the software engineering literature (Sommerville, 2001). Functional requirements include: Information distribution, Communication, Assessment, Management and Administration. Non-Functional requirements include: Pedagogy approaches, Integration, Personalization and customization and attractive interphases.

c) Meta-Design

The meta-design component of the ISDT encapsulates a range of features or design principles intended to fulfill both the functional and non-functional requirements identified above. Nanard et al. (1998) and Catlin et al. (1991) proposed Hypermedia templates, Platform independence, and Object Oriented Design patterns for the non-functional requirements. Gamma et al. (1993) and Fowler (2003) advocated for Authentication and Access control, Discussion forums and Chat

rooms, online quizzes and online assignment and customizable interfaces for the non-functional requirements.

d) Design Method

According to Truex et al.(1999), the development practices for e-learning should reject or place less emphasis on traditional software development practices and instead adopt those of emergent and agile development methodologies (Highsmith and Cockburn, 2001). This makes it possible for developers to achieve alignment between the organization and its information systems (duPlooy, 2003).

f) Theory Hypotheses

Drawing on principles from the kernel theories of the e-learning ISDT, it is possible to pose a range of hypotheses that are open to empirical testing. Table 3 provides an overview of the testable design product and process hypotheses for and an indication of which kernel theories the hypotheses are drawn.

Table 3: ISDT's Testable Design Hypotheses

Kernel theory	**Hypotheses**
Hypermedia templates	It is possible to construct an IS for e-learning using hypermedia templates as the main system abstraction..
Design Patterns & source software	Use of this ISDT will produce an IS which is flexible, open and Customizable.
Emergent/Agile development	Overtime the IS produced from this ISDT will become customized to the needs and requirements of the particular organization and consequently provide a possible source of strategic advantage.
Diffusion theory	A system built using this ISDT will be acceptable to users as demonstrated by regular and increasing use

2.2.2 Formulated ISDT for E-learning

The section has presented an Information Systems Design Theory for the design and support of Information Systems intended to support e-learning. The theory can be useful for both

practitioners and researchers. For practitioners it offers theory-based guidance about how to design and implement quality information systems for e learning.

The formulated ISTDT for the study provides three benefits: (1) it identifies number of theory-based principles that are subject to empirical validation. (2) It provides an IS underlying e-learning that is more flexible, customizable and close to the needs of specific HEIs. (3) It provides a guide on how an e-learning evaluation model can be derived by identifying Meta Requirements, Design Methods, Meta Design and Testable Design Hypotheses. Figure 2 represents the formulated ISDT theory.

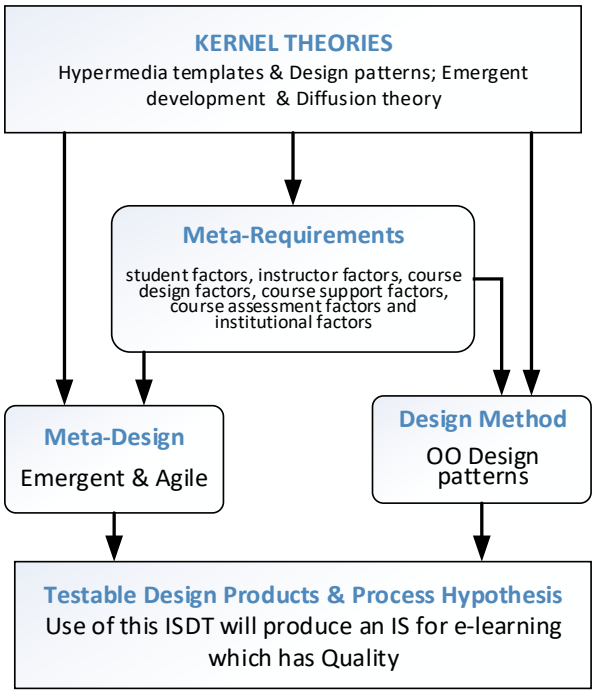

Figure 2: ISDT for e-learning System Quality

2.3 Review of Context Relevant Literature

2.3.1 Journal Review analysis and the Research Gap

The study conducted a systematic review of literature on e-learning quality evaluation. Such a review is normally based on a clearly formulated question that helps in identifying relevant studies, appraises their quality and summarizes the evidence by use of explicit methodology (Khan et al, 2003). Before conducting the review, the research problem was specified in a clear and structured manner by framing it using specific keywords. Some of the keywords used

included e-learning quality evaluation frameworks, models, quality factors, model review, structured equation modeling and challenges of e-learning in HEIs all over the world.

To capture as many relevant articles as possible, a range of education, technology and e-learning journals were searched extensively to identify primary studies on the determinants of quality e-learning systems plus the challenges and mitigations HEIs have put in place to improve learning provision. Twenty (20) journals were reviewed and shortlisted of which four (4) were found to publish articles related to the problem of the study. The journals were: the International Review of Research in Open and Distributed Learning (IRRODL); The Electronic Journal of e-Learning *(*EJEL*);* International Journal of Education and Development using ICT(IJEDICT) and the International Journal of E-Learning & Distance Education(IJEDE).

Eighty five (85) articles based on the keywords above were identified and downloaded from the listed journals. Among the articles were those dealing with how to the studies were conducted and how the data was analyzed. After further scrutiny of the articles, fifty (50) were found to cover the study topic in general while only twenty-seven (27) were found to cover the nine (9) constructs of quality used for the study. These constructs summarized in table 4.

Table 4: E-learning Quality Factors from Literature

QUALITY FACTORS	Aung & Khaing(2016)	Mayes & Freitas (2013)	Raspovic et.al(2014)	De-Lone and McLean(2003)	Mtebe & Raisamo(2014)	Sseka kubo et al.(2011)	Tarus, Gichoya & Muumbo(2015)	Makokha & Mutisya(2016)	Muuro et al.(2014)	Chawinga(2016)	Kisanga(2016).	Biggs & Tang (2007)	Wright(2014)	Omwenga & Rodriguez(2006)	Zhang & Cheng (2012)	Masoumi & Lindstrom(2012)	Kashorda & Waema(2014)	Kihoro et al.(2014)	Weng and Chung (2015)	Queiros & de Villiers (2016)	Azawei et al.(2016).	Baloyi (2014)	Lim, Park & Kang (2016)	Arinto (2016)	Mayoka & Kyeyune(2012)	Bagarukayo & Kalema (2015)	QMRS (2014)	Frequency
Constructs																												
Course Design		x					x	x			x	x	x		x	x		x				x	x				x	12
Content support															x			x				x	x				x	5
Social Support									x						x				x	x								4
Administrative Support																x	x	x			x							4
Institutional Factors		x				x	x				x	x		x	x	x	x	x			x					x		12
Course Assessment										x	x	x	x		x	x								x				7
Learner Characteristics						x	x																	x				3
Instructor Characteristics					x	x	x	x													x				x			6
E-learning System Quality			x	x										x														3

2.4 Status of E-learning in Kenya

Kenya had a total of 33 Public and 17 private universities according to the Commission of Higher Education (CUE, 2015) by the year 2015. Most of the institutions had started offering a few e-learning courses in a blended and fully online format (Kashorda & Waema, 2014), with the main mode of learning being asynchronous Learning Management System (LMS) supported (Ssekakubo et al, 2011). However, most of the Universities have not invested sufficiently in infrastructure and course development (Kashorda & Waema, 2014). Studies in Kenya show that the main hindrances facing e-learning are: inadequate ICT and e-learning infrastructure, Financial constraints' lack of affordable and adequate Internet bandwidth, lack of operational e-learning policies, lack of technical skills on e-learning and course development by the teaching staff (Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014).

2.4.1 Selection of JKUAT as a Case Study

JKUAT started e-learning initiatives way back in 2006. However it was not until the year 2012 when the former school of e-learning was merged with a directorate that was offering the fast depleting continuing education to form the School of Open Distance Education and Learning(SODEL) in the year 2016. According to Kihoro et al. (2014), JKUAT uses asynchronous e-learning mode of study supported by Moodle LMS hosted at JKUAT. Among the programmes offered include masters, undergraduate, diplomas and certificates (SODEL, 2016).

The choice of JKUAT as the case study was arrived at on the basis of its past and current e-learning activities. By visiting the websites of at least six universities offering e learning in Kenya (JKUAT, Nairobi, Kenyatta, Maseno, Egerton and Moi), information in terms of the number and level of programmes offered was obtained. However, contact persons who were lecturers and researchers working in these Universities provided further information about the nature of e-learning in the institutions. The combination of the information from the two sources enabled the researcher to settle on JKUAT as the most appropriate university for the study. The main reasons for the decision were:

i. JKUAT has the largest population of pure online students approximately 350. No other University in Kenya has such a large number of online students.
ii. JKUAT has a variety of postgraduate programmes (six in number) providing a variety for a good sample.
iii. Collecting data from JKUAT was easy as it was done when all the students had reported for examinations at the end of the semester.
iv. A study by Kihoro et al. (2014) proved that JKUAT suffer similar problems faced by the other Universities in Kenya such as inadequate internet connectivity, poorly developed courses, poor online support, and limited online interaction with students, limited computers and computer labs.
v. Collecting data from the respondents proved to be easy as it was coordinated through the e-learning Director at SODEL.
vi. Most of the programmes by other universities are blended for example in Egerton and Maseno Universities or are open learning like in Kenyatta University, so their respondents could not respond adequately to the instruments, which were for fully online students.

2.5 Key Factors for E-learning System Quality

This section describes how the e-learning quality determining factors relate to the quality of e-learning systems as captured from the literature review.

2.5.1 Course Design

At the design stage, the *people* include the research and design (R&D) coordinator, who leads the e-learning course design process. With a comprehensive understanding of learners' needs, institutional capabilities, and experience in e-learning design and research, the R&D coordinator is responsible for reviewing course content for pedagogical soundness and the selection of the appropriate delivery medium. In this stage, the people involved include instructional designers, as well as those who work with subject matter experts, interface designers, copyright coordinators, and evaluation specialists (Khan, 2004).

Course Design consists of what constitutes the course e.g. instructional objectives, course information, course layout and course organization (Wright, 2014; QMRS, 2014). A descriptive

study by Mtebe & Raisamo (2014a) found out that well designed courses had a tendency to increase satisfaction and maximize LMS use, and increase learners' satisfaction with the system. Studies by Tarus, Gichoya & Muumbo (2015) and Chawinga (2016) confirmed that well designed courses appropriate to learners' knowledge, skills and abilities improved quality. Makokha & Mutisya (2016) in a study to establish the status of e-Learning in Public Universities in Kenya through a descriptive survey observed that poorly designed courses were responsible for low interactivity.

2.5.2 Content Support

The use of multimedia coupled with solid content and appropriate instructional methods can greatly influence the learning process (Tchoubar, 2014). Multimedia Improves learning by keeping the learners engaged and motivated to learn. Using audio narrations can reduce help learners remain focused on the visual (animations) in the screen while the use of videos and animations can explain complex concepts more effectively than standalone text (Kazaine, 2015). Support tools such as discussion forums help students in terms of improving their learning skills according to Shana (2009) with the learners describing forums as a flexible, convenient, attractive, motivating and satisfying mode of communication. Research shows that both forum and chat activities enables participants to asynchronously share and exchange their ideas and experiences independently with or without their instructor's participation (Wu et al, 2012).

2.5.3 Social Support

Weng and Chung (2015) in a study on social support as a neglected e-learning motivator affecting online students observed that user satisfaction in e-learning was supported by managerial support, peer support as well as family support. According to Weng and Chung (2015), social support from different sources, such as, peers, forum, chat and e-learning group work proved to be influential in improving quality. Studies by Muuro et al. (2014) and Queiros & de Villiers (2016) using a descriptive survey with cross-sectional approach confirmed that strong social presence through timely feedback, interaction with facilitators, peer-to-peer contact, discussion forums and collaborative activities influenced learning in a positive way.

2.5.4 Course Assessment

E-learning course assessment in the study refers to the administration of assignments, continuous assessment tests (CATs) and end semester examinations. Chawinga (2016) established that some universities delayed in providing feedback of assignments and release of end of semester examination results. Similarly, Makokha & Mutisya (2016) observed that some instructors failed to include online quizzes and self-assessment tests in their courses, which led poor performance in assessment of the learners.

Assessments are critical in measuring the learning objectives and therefore they ought to be feasible, relevant, accurate, and congruent with both the objectives and the course content (Wright, 2014; QMRS, 2014). Besides, learners deserve to be given clear expectations and criteria for credit assignments, reasonable number of assignments and their due dates and appropriate links to institutional policies on grading and evaluation (Wright, 2014). Delay in providing assessment feedback should be avoided as it can negatively affect learner's performance (Chawinga, 2016).

2.5.5 Institutional Factors

Tarus, Gichoya & Muumbo (2015) revealed that Inadequate ICT and e-learning infrastructure, Financial constraints, Lack of affordable and adequate Internet bandwidth, Lack of operational e-learning policies, Lack of technical skills on e-learning and e-content development by the teaching staff and Lack of interest and commitment among the teaching staff to use e-learning were the challenges hindering Implementation of e-Learning in Kenya. Similarly, Azawei et al. (2016) in a study to establish the barriers and opportunities of e-learning Implementation in Iraq observed that Low internet bandwidth, Insufficient financial support, Inadequate training programs, Lack of technical support, Lack of ICT infrastructure, Ambiguous plans and policies and lack of interest and motivation were the main barriers to quality e-learning implementation.

The above findings were confirmed by Mayoka & Kyeyune(2012) in a study to analyze the adoption of e-learning Information System in Ugandan Universities observing that lack of computers and software for implementing e-learning, lack of e-learning skilled staff in universities, lack of policy and guidelines for using e-learning in universities, lack of government

support for e-learning projects, high cost of telecommunication services and lack of resources for implementing e-learning projects were the main quality issues facing e-learning adoption in Uganda.

2.5.6 Learner Characteristics

Baxter (2012) revealed that positive past learning experiences such as success in passing modules created confidence in e-learning students. He also added that student retention and progression in e-learning could be improved by interaction using tools such as such as Facebook to help social and academic integration. How lecturers perceive students and how students interact with each other may increases self-confidence in e-learning.

Similarly, KUO, Yu-Chun et al. (2013) observed that learner-to-learner interaction influenced student satisfaction in e-learning because it acted as a two-way reciprocal communication between or among learners who exchange information, knowledge, thoughts, or ideas regarding course content.

Another influencing factor was found to be learner motivation (Jung, 2017). Both intrinsic & extrinsic motivation is crucial to the learners' success in an online coursework environment because they can influence their decisions to stay in or drop out of a course, their degree of engagement in the course and their level of achievement in the course (Hartnett, 2016; Bonk & Khoo, 2014).

2.5.7 Instructor Characteristics

Wang and Cowie (2008) study on challenges of e-learning for University Instructors in Taiwan, observed that instructors are continuously faced with pedagogical, personal, and technological challenges such as having little or no formal training in the effective use of technological resources in e-learning, computer anxiety in the early stages of e-learning adoption and time needed to prepare e-learning lessons. Similarly, Mtebe & Raisamo (2014b) study on the challenges of Instructors' Intention to Adopt and Use Open Educational Resources in Higher Education in Tanzania observed that inadequate ICT infrastructure, a low level of internet connectivity and an inadequate number of computers were hindrance factors.

In a related study by Busaidi & Alshihi (2010), instructor factors such as self-efficacy, attitude towards e-learning, experience and motivators or incentives for instructors were found to play a key role in determining quality.

2.5.8 E-learning System Quality

An institution practicing e-learning should be geared towards investigating whether the system provides user satisfaction, information quality, service quality and academic achievement (Raspopovic et.al ,2014; Delone and McLean, 2003; Mtebe & Raisamo, 2014a). Based on the studies above, user satisfaction regards satisfaction with the LMS, the learning effectiveness and cost effectiveness. Information quality deals with quality of the courses. Academic achievement refers to performance in academics such as Continuous Assessments Tests (CATs) and Examinations.

2.5.9 Choice of Moderator Variables

Moderator variables can be qualitative (e.g., gender, age, culture) or quantitative (e.g. learner characteristics, instructor characteristics) (MacKinnon, 2012). Moderators are also known to have the power to accurately explain user's acceptance and use of technology innovation thus improving the explanatory power of a model (Sun & Zhang, 2006). Both learner and instructor characteristics were used as moderating variables in investigating students' acceptance of online learning (Bouzaabia, Bouzaabia, Melika, 2013; Selim & Chiravuri, 2015). The ideal variables for moderators in the study were found to be learner characteristics and instructor characteristics.

2.6 Qualitative Pre-study

Following the derivation of the factors for e-learning system quality from literature, a qualitative pre-study was conducted at JKUAT in order to explore all the important elements of an e-learning system quality. The study was conducted between July and August 2016. According to Manerikar & Manerikar (2014), explorative studies are undertaken in order to provide a greater understanding of a research problem by clarifying and defining the nature of that problem. In the study, the opinions of instructors, students, technicians and the e-learning Deputy Director at JKUAT regarding e-learning were sought using focus group interviews.

The specific objectives of this phase were:

i. To gain an understanding, from the perspective of key stakeholders, of factors that affect e-learning quality in JKUAT

ii. To breakdown the role played by these factors, either as barriers or enablers of quality e-learning system

iii. To understand the perceived opportunities and threats that the JKUAT e-learning system faces in its agenda of providing quality education.

iv. To make recommendations on how barriers and threats can be addressed to improve the quality of e-learning in JKUAT.

Subsequent analysis and synthesis of the findings was done to identify the factors needed to develop a review tool and eventually an e-learning quality evaluation model that covers all of the important elements in HEIs. The following sections describe the approach and key findings from this phase.

2.6.1 Pre-study Methodology

Data was collected at random from thirty respondents including: twenty students, five instructors, four technicians, and one administrator. All the respondents were subjected to interviews. During the interviews, the respondents were expected to describe their e-learning experiences in terms of challenges and benefits as well as the recommendations for improving the system in order to reap maximum benefits from e-learning.

Each interview was treated as an individual case, and the transcribed data was analyzed with the NVivo qualitative data analysis software (NQDAS). NVivo assisted in the qualitative analysis process by enabling easier data management, storage of the interview transcripts, and help in coding the text and provided an interface for quick exchange with SPSS for further statistical analysis.

Finally, the researchers identified patterns across categorized data and used them to draw conclusions and recommendations on factors that need to be addressed in order to improve the quality of e-learning in JKUAT.

The next section discusses some of the key factors identified from the pre-study as perceived opportunities and challenges based on stakeholder's perspectives and their potential impact on the JKUAT e-learning system.

2.6.2 Pre-Study Findings and Discussions

Tables five (5), six (6) and seven (7) presents the pre-study results for students, instructors and technicians respectively. The findings are discussed below.

Table 5: Students Pre-Study Results

Pre-study Factors	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
	N (%)	N (%)	N (%)	N (%)	N (%)
Administrative Support is important for e-learning	4(20%)	2(8%)	3(12%)	6(30%)	6(30%)
Content Support is important for e-learning	3(16%)	3(16%)	2(8%)	6(30%)	6(30%)
Tech support is important	1(6%)	4(22%)	1(6%)	6(28%)	6(28%)
Good administration of Assessment	4(18%)	3(18%)	1(6%)	5(22%)	7(36%)
Training is important	3(16%)	3(16%)	2(8%)	6(28%)	6(32%)
Motivation is important	2(8%)	3(16%)	2(10%)	8(36%)	5(20%)
Course Quality is important	2(16%)	5(26%)	1(4%)	6(24%)	6(30%)

Number of respondents: (N = 20)

The results from table 5 show that over 54% of the students feel that: Administrative Support, Technical support, Good administration of Assessment, Training is important and Motivation are important factors that influence the quality of an e-learning system.

a) Administrative support

The students reported that the administrative support they received such as physical orientation of the university, academic advice, course registration and any other relevant information that is needed for their studies was critical in assisting them to adapt to the e-learning mode of study quickly. The students visit the campus on two occasions. During course registration at the beginning and during examinations and continues assessment tests at the end of the semester.

b) Content Support

The students however complained that their course content was not sufficient to enable them attempt their examinations. The content was too brief and there were no supporting links in some cases to compensate for the brief content. Although other students reported the availability of videos in some of their courses, the majority concurred that their content was mainly made up of text in the form of Portable Document Format (PDF) or PowerPoint.

c) Course Assessment

Although majority of the students reported that they were generally happy with the administration of their assessment as a whole, others expressed dissatisfaction with the way their assignments, examinations and continues assessment tests were handled. While some complained that there were too many assignments with constrained deadlines, others added that they were never given feedback from their assignments and CATs.

Another group of students reported that some of their examinations marks had been misplaced by the university forcing them to repeat the examinations in the form of special or supplementary exams. Other students were also adamant that delays in the outcome of their exam results did occur at times forcing them to commence a new semester without having received results for completed semester.

d) Quality of Content

A section of students reported that most of the learning materials posted on their LMS platform consisted of PDFs and PowerPoint's which they did not find to be interactive. The students

suggested that it would be better if their instructors included some audio, video and images to make learning a bit livelier.

e) Internet Connectivity

The students complained about the inaccessibility of the JKUAT e-learning portal at times due to internet connectivity issues. Connectivity was at times inadequate making the bandwidth incapable downloading notes in the form of PDFs.

Table 6: Instructor Pre-Study Results

Pre-study Factors	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
	N (%)	N (%)	N (%)	N (%)	N (%)
JKUAT has adequate Funding	0(0%)	0(0%)	0(0%)	3(60%)	2(40%)
Training is important	0(0%)	0(0%)	0(0%)	3(60%)	2(40%)
Motivated is important	0(0%)	0(0%)	0(0%)	2(40%)	3(60%)
e-learning Culture is important	0(00%)	0(0%)	1(20%)	2(40%)	2(40%)

Number of respondents: (N = 5)

According to the results in table 6, over 75% of the instructors reported that funding, training, motivation and an e-learning culture can improve the quality of e-learning system. The JKUAT e-learning instructors expressed fear that lack of motivation and incentives related to e-learning was a source of concern. They added that limited funding for e-learning support and expansion, poor instructor remunerations and handling too many students were hindering the quality of e-learning provision. A number of the instructors suggested that they would rather look for consultancy or part time classes in other universities to earn extra money that than struggle trying to facilitate e-learning**.**

Table 7: Technician Pre-study Results

Pre-study Factors	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Funding is important	0(0%)	(0%)	0(0%)	1(25%)	3(75%)
Training is important	0(0%)	0(0%)	0(0%)	3(75%)	1(25%)
Motivation is important	0(0%)	0(0%)	0(0%)	2(50%)	2(50%)
e-learning Culture is important	0(0%)	0(0%)	1(25%)	1(25%)	2(50%)

Number of respondents: (N = 4)

According to the results in table 7, over 75% of the technicians reported that funding, training, motivation and e-learning culture are influential in improving e-learning systems quality. E-learning technicians are responsible for maintaining the Universities' computer services and equipment. Their duties include troubleshooting computers to detect and solve technical problems, installing or updating required hardware and software and recommending computer products or equipment to improve universities e-learning system. The JKUAT e-learning center (SODEL) is assigned four (4) e-learning technicians who informed the researcher that their duties included installing and customizing the LMS, creating user accounts, uploading content and even assisting students with issues regarding the technical aspects of e-learning.

2.6.3 Linking the Pre-Study Factors to Quality Factors

A close examination of the pre-study factors identified in this phase confirmed that many could be linked to the constructs already identified in literature. This confirmed to the researcher that some of the factors identified in literature are relevant for e-learning in HEIs. However, some of the factors could not be linked to literature so they were added to the existing factors from literature as new factors.

The pre-study supported all of the factors found from literature except for two constructs and four indicators: the constructs were administrative support and technician characteristics while

the indicators were e-learning culture, examinations, assignments and Continues Assessment Tests (CATs). Both set of factors from the literature and the pre-study are summarized in table 8.

Table 8:Pre-Study and Literature Review Quality Factors

	Constructs	indicators	Source	Author
1	Course Design	Course information, course structure, course layout,	Literature	Quality Matters Rubric Standards (2014), Wright (2014), Makokha & Mutisya(2016); Tarus, Gichoya & Muumbo(2015)
2	Content support	Announcements & reminders, Use of multimedia, Constructive feedback, Authentic learning activities	Literature and pre-study	Tchoubar (2014), Kazaine (2015), Shana (2009), Wu et al.(2012)
3	Social Support	Informational Support, Instrumental Support, Affirmation support and Emotional Support	Literature	Weng & Chung(2015), Munich(2014), Muuro et al.(2014),Queiros and de Villiers (2016)
	Administrative Support	Registration support, orientation, call center,	Pre-study	
4	Assessment	Assessment policies, assignments management, timely feedback, grades management	Both Literature and pre-study	Chawinga (2016),Arinto (2016), Makokha & Mutisya(2016),Wright(2014)
5	Institutional Factors	Policies, funding, infrastructure, culture,	Both Literature and pre-study	Kashorda & Waema(2014), Ssekakubo et al.(2011), Tarus, Gichoya & Muumbo(2015)
6	Learner characteristics	Computer and internet experience, Passion about e-learning, Motivation from instructors, Good access to university e-learning system	Literature	Baxter(2012),Kuo, .et, al. (2013), Hartnett (2016),Bonk & Khoo (2014)
7	Instructor characteristics	Self-efficacy, training, motivation, incentives, experience	Both Literature and pre-study	Wang and Cowie (2008), Mtebe & Raisamo(2014b).Busaidi & Alshihi (2010)
8	Technician characteristics		Pre-study	
9	e-learning system quality	user satisfaction, learning effectiveness, academic achievement, cost effectiveness	Literature	Mayes & Freitas (2013), Biggs (1999), ENQA (2013) Raspopovic et.al, (2014) De-Lone and McLean, 2003; Mtebe & Raisamo, 2014a).

2.6.4 Study Model Development and Pre-Study

The main objective when conducting the pre-study was to establish if it is possible to categorize the factors identified by the pre-study with those identified from literature. The result was that the qualitative study supported all of the constructs in the literature as summarized in the previous section. Additionally, it contributed to the identification of new constructs and indicators to be included in the review tool namely: Administrative Support and Technician Characteristics (constructs). Incentives, Culture, Assessment management (Indicators). Similar to literature, the pre-study also identified student characteristics and instructor characteristics as moderating variables. However, the technician characteristics was identified as a new variable applicable in the study context.

As discussed in the preceding sections, conceptualization of the review tool followed a detailed approach where information acquired through literature review was jointly synthesized with insights from a qualitative pre-study. This led to an extension of the quality factors identified above. Figure 3 illustrates the conceptualization of the review tool after including the constructs and indicators from pre-study. The added constructs and indicators are shaded in dark color.

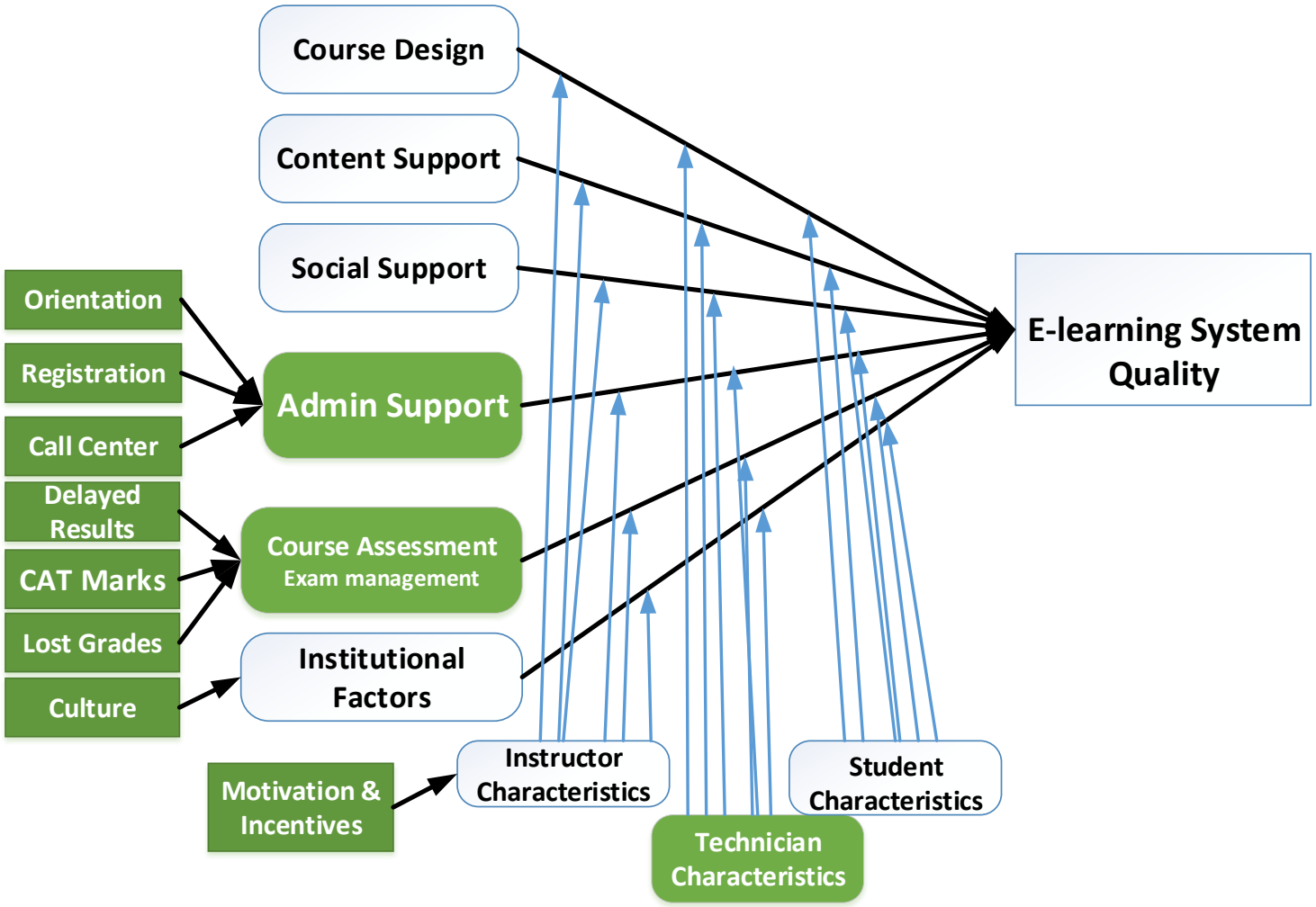

Figure 3: Derivation of the Review Tool

2.7 Development of Review Tool

In order to review the existing e-learning frameworks and models of quality, it was important to establish a basis for the review. This was done by using the quality factors from both the literature and the pre-study to create the review tool. This tool was based on Biggs Framework for Quality Learning.

2.7.1 Biggs Framework for Quality Learning

Biggs & Tang (2014) introduced a model for quality course design and education based on the constructivist theory (figure 4). The framework had previously been used in the review of some e-learning theories, frameworks and models (Biggs & Tang, 2014; Mayes & Freitas, 2013). The model advocates for aligning the intended learning outcome with the teaching and learning activities; the assessments; reviewing the courses and providing context for effective learning and teaching. It is important to note that Biggs dwells on quality of education in HEIs only and therefore needs to be integrated with quality e-learning. As a result, modification and extension of the framework was necessary to include the e-learning quality factors from literature and pre-study.

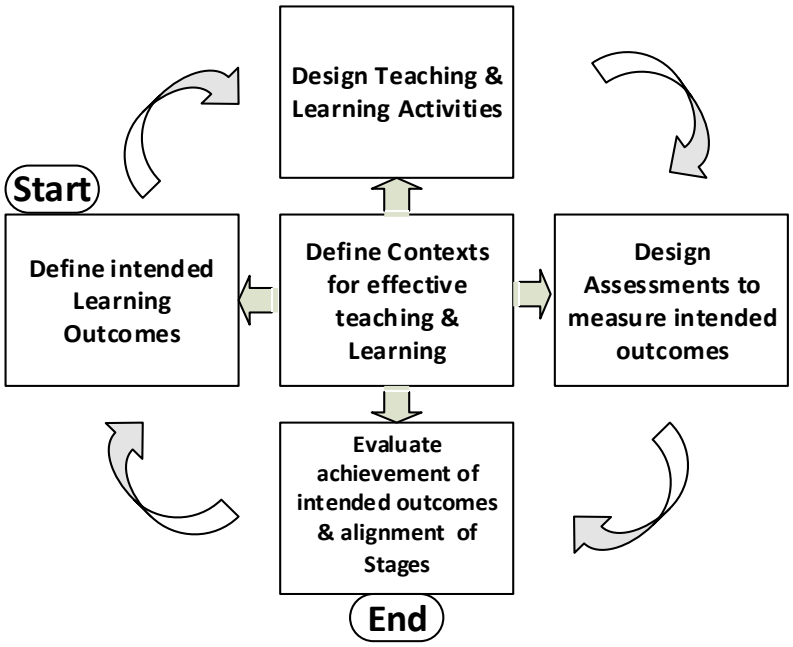

Figure 4: Biggs Framework of Quality Learning.
Source (Adopted from: Biggs & Tang, 2007; Mayes & Freitas, 2013).

2.7.2 Integrating Quality Factors into Biggs

In order to integrate the quality factors into Biggs Framework, the process of conceptual framework analysis was used. This is an iterative process requiring a steady movement between concept and data, as well as comparative, requiring a constant comparison across types of evidence to control the conceptual level and scope of the emerging theory" (Orlikowski, 1993). The process includes 6 phases: 1) Mapping the selected data sources, 2) Extensive reading and categorizing of the selected data, 3) Identifying and naming concepts, 4) Deconstructing and categorizing the concepts, 5) Integrating concepts that have similarities and finally 6) Synthesis, re-synthesis, and making it all make sense.

Therefore, the study undertook to split, rename, map and fit constructs and indicators to the framework. Accordingly, the intended learning outcome was combined with design of teaching and learning activities and then split into four: course design, content support, social support and administrative support. The contexts for effective teaching and learning were renamed as institutional factors while the design of assessments was retained. The evaluation of achievement of outcomes was renamed as the e-learning system quality dependent variables while three new variables (student characteristics, instructor characteristics and technician characteristics) were used as moderator variables. Table 5 section 2.6.3 summarizes the results

2.7.3 E-learning Quality Frameworks/Models Review Tool

The review tool was created using the constructs and indicators presented in table 3. The diagram in figure 5 represents the tool.

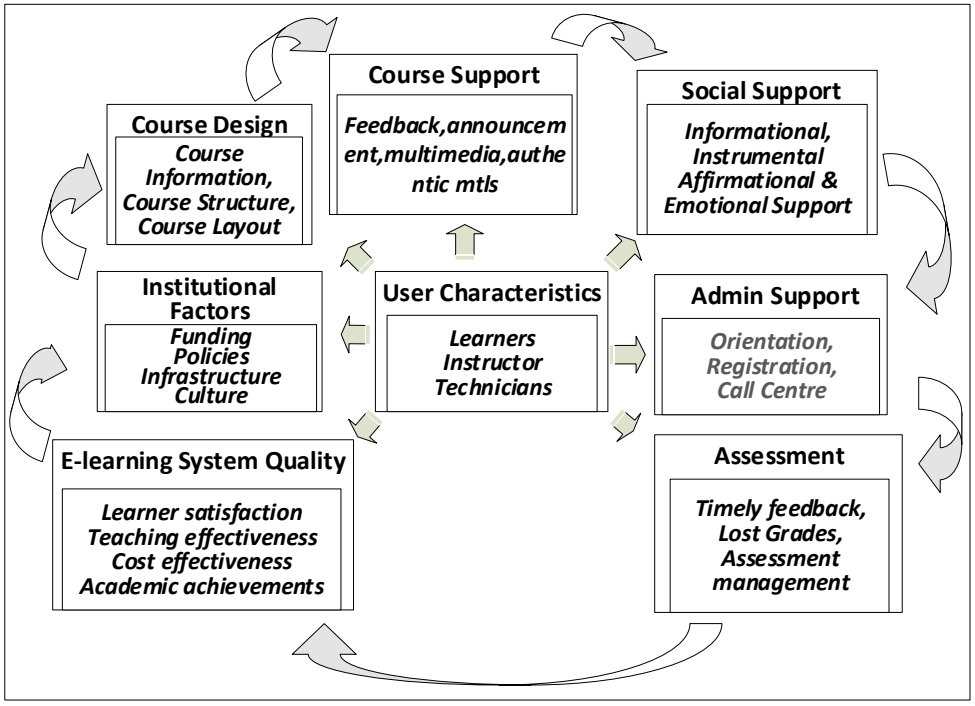

Figure 5: E-learning Model/Framework Review Tool.
Source (Adopted from Biggs Framework)

2.8 Review of Existing Models and Frameworks

This section involves comparing the constructs and indicators of five (5) e-learning frameworks and models of evaluation using the review tool with the view of answering the following eight (8) broad questions:

i. Does the model or framework evaluate course design via course information, course structure, and course layout and course organization?

ii. Does the model or framework evaluate content support using course reminders, feedback, multimedia use and authentic learning materials?

iii. Does the model or framework evaluate social support through Informational Support, Instrumental Support and Emotional Support?

iv. Does the model or framework evaluate administrative support based on orientation, registration support, academic advice and a call center?

v. Does the model or framework evaluate assessment methods that effectively administer and safeguard student grades and provide timely feedback?

vi. Does the model or framework evaluate institutional factors such as availability of polices funding and infrastructure for e-learning?

vii. Does the model or framework take into consideration how user characteristics affect the quality of the e-learning system provided?

viii. Does the model or framework regularly review the e-learning system with the view of evaluating user satisfaction, learning effectiveness, academic achievement?

The process involved mapping of the evaluation models and frameworks to Biggs Framework for the purpose of comparisons.

2.7.1 The P3 Course Evaluation Model

The People, the Processes and the Product (P3) model was developed by Khan (2004) and advocates for the evaluation of three dimensions of e-learning. The People, the Processes and the Product. In e-learning, *people* are involved in the *process* of creating e-learning materials, or *products* and making them available to its target audience. The P3 model can be used to map a comprehensive picture of e-learning. The specific factors involved are the Planning process, the Design processes, the Development processes and Evaluation processes. This model is illustrated in figure 6.

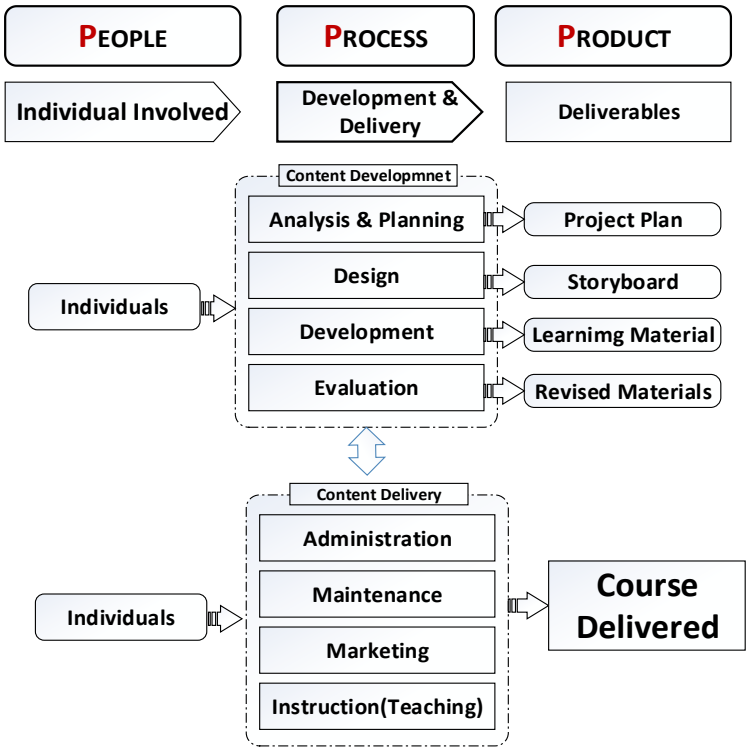

Figure 6: P3 Evaluation Model
Adopted from (Khan, 2004).

2.7.2 Mapping P3 Model to Review Tool

Mapping of the P3 model factors into the Review Tool Factors (RTF) was done in order to determine the factors that contributed to the conceptual model as well the weaknesses of the P3 model in terms of factors it did not have. By closely scrutinizing the P3 model, the following observations were made: (1) P3 does not fully support content support, social support, administration support and assessments. (2) P3 partially support course design, institutional factors, and user characteristics. The supported indicators are course layout, infrastructure, culture, multimedia and learner characteristics.

The unsupported indicators are: Course information, course structure, course organization, Feedback, Announcements and Authentic materials, Chats, Forums, Group work, Orientation, Registration, Academic advice, lost grades, learner satisfaction, cost effectiveness, teaching effectiveness, academic achievements, funding and policy.The mapping for the P3 model is represented in Figure 7. Font with no strikethrough portrays the support of a construct or an indicator by the model while font with a strikethrough shows no support. This format of mapping is used in all the mapping diagrams in this section.

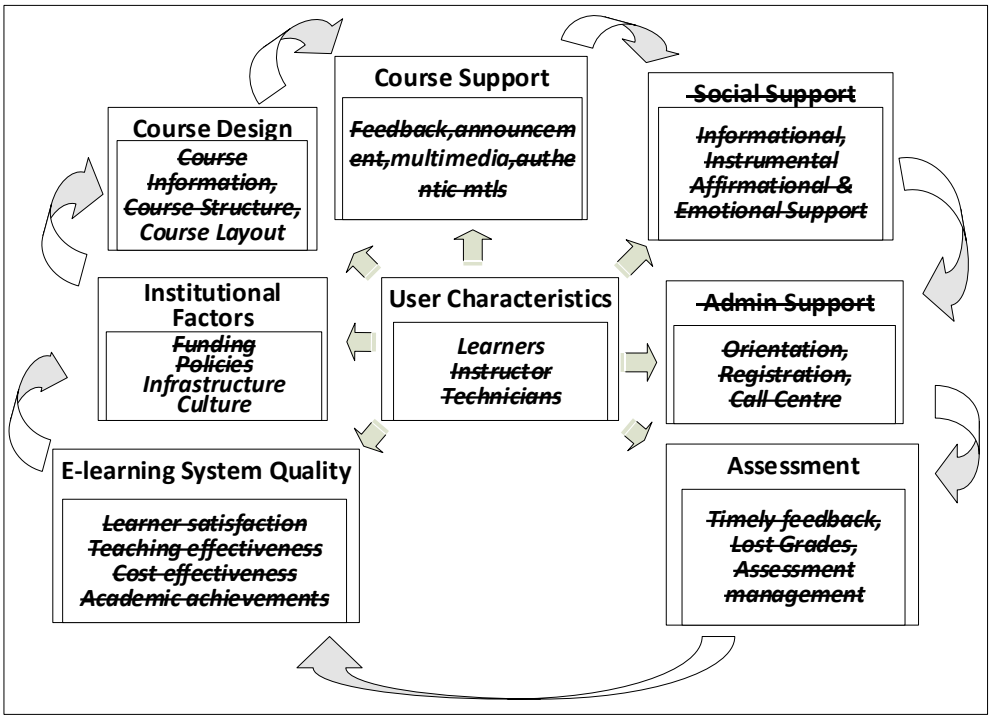

Figure 7: Review Tool after Mapping with P3

2.7.3 The PDPP Evaluation Model

The Planning, Development, Process, and Product (PDPP) evaluation model consists of four-phases of evaluation for e-learning course quality: Planning evaluation includes market demand, feasibility, target student group, course objectives and finance. Development evaluation includes instructional design, course material development, course website design, flexibility and student-student interaction, teacher-tutor support, technical support and, and assessment. Process evaluation includes technical support, Web site utilization, learning interaction, learning support and flexibility and Product evaluation includes learner satisfaction and teaching effectiveness (see figure 8).

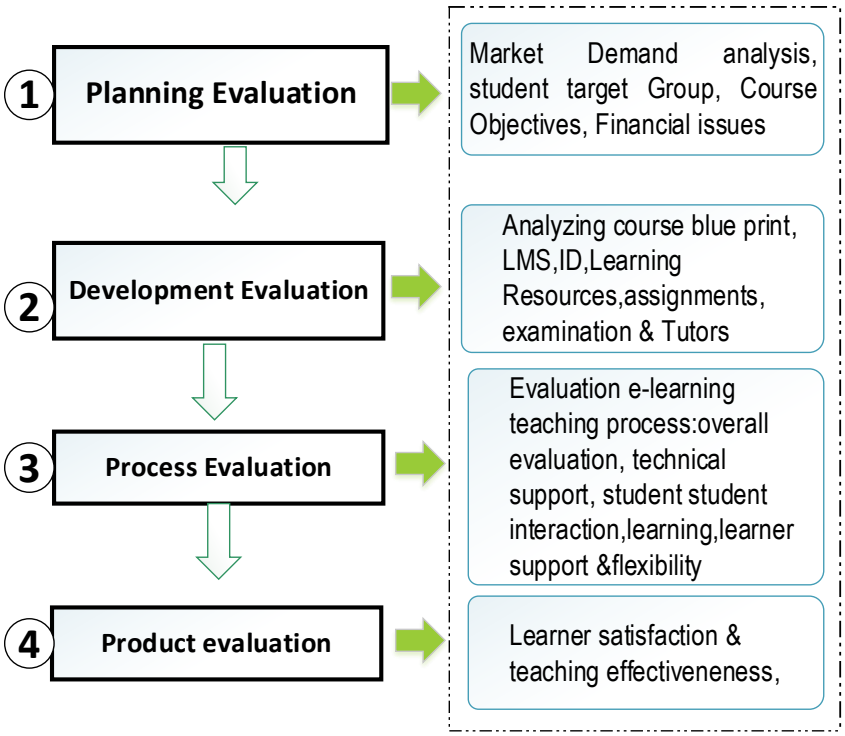

Figure 8: PDPP Evaluation Model
(Adapted from: Zhang & Cheng, 2012)

Unlike other models, the PDPP does not evaluate the effects of institutional and administrative support as well as the effect of user characteristics. The PDPP evaluation model was used in a case study of e-learning course at the University of Hong Kong and Peking University (Zhang & Cheng, 2012).

2.7.4 Mapping PDPP Model to Review Tool

The following observations were made when PDPP was mapped to Review Tool. PPDD does not fully support social support and administration support. The rest are partially supported. The supported indicators are: assessment, learner satisfaction, teaching effectiveness, learner characteristics, instructor characteristics, infrastructure, culture, funding, course structure and multimedia. The unsupported indicators are: Course information, course layout, Feedback, Announcements and Authentic materials, Chats, Forums, Group work, Orientation, Registration, Academic advice, lost grades and Technician Characteristics. The mapping for the PDPP model is represented in Figure 9.

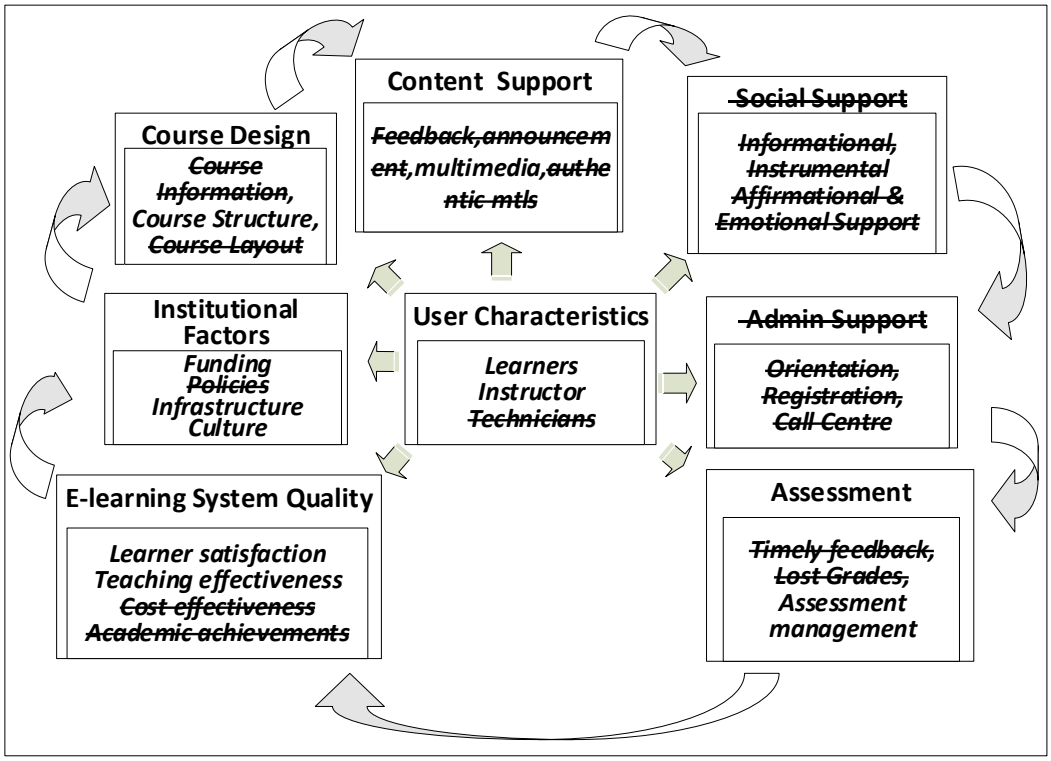

Figure 9: Mapping PDPP Model to Review Tool

2.7.5 E-learning Quality Framework

The E-learning Quality Framework (EQF) uses seven (7) determinants for evaluation: institutional factors, technological factors, pedagogical factors, student support factors, faculty support factors, instructional design factors and course evaluation factors (see figure 10).

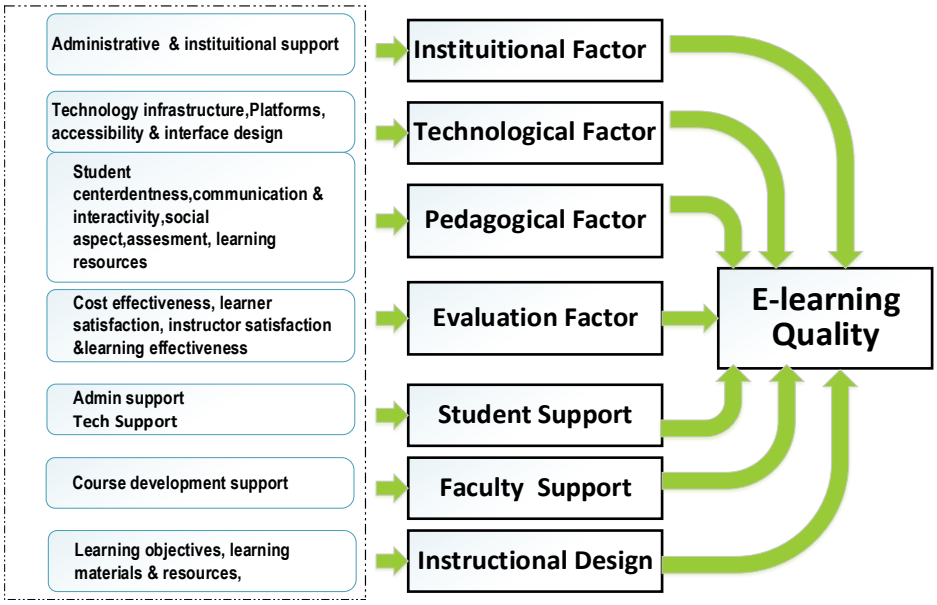

Figure 10: e-learning quality framework
(Adapted from: Masoumi & Lindstrom, 2012)

The seven factors of the framework can be explained as follows.

- **Technological factor:** deals with infrastructure, LMS platform and accessibility.
- **Institutional Factor***:* deals with administrative institutional support.
- **Instructional Design factor:** deals with learning objectives, learning materials and resources.
- **Faculty Support***:* This factor is partially related to the technological factor and it partially covers the field of a course creation.
- **Student Support***:* deals with administrative support and technical support.
- **Evaluation Factor***:* This can be divided into a subjective and an objective group. Subjective group consists of the students' satisfaction and teacher's satisfaction. Objective group is formed by learning effectiveness measurable tests or alternatively by the results classification. Cost effectiveness is the combination of the financial burden at the teacher side and the financial benefit at the student side.
- **Pedagogical factor***:* This is largely oriented to content, communication and used resources.

2.7.6 Mapping EQF to Review Tool

The mapping of the EQF to review tool confirms that both content support and social support are fully supported with the remaining constructs only partially supported. Course structure, learner and instructor characterictics, user satisfaction, teaching effectiveness, infrastructure, culture, and multimedia are supported. Course information, course layout, funding and policies, academic achievements, assessment management and technician characteristics are not supported. The mapping for the EQF model is represented in Figure 11.

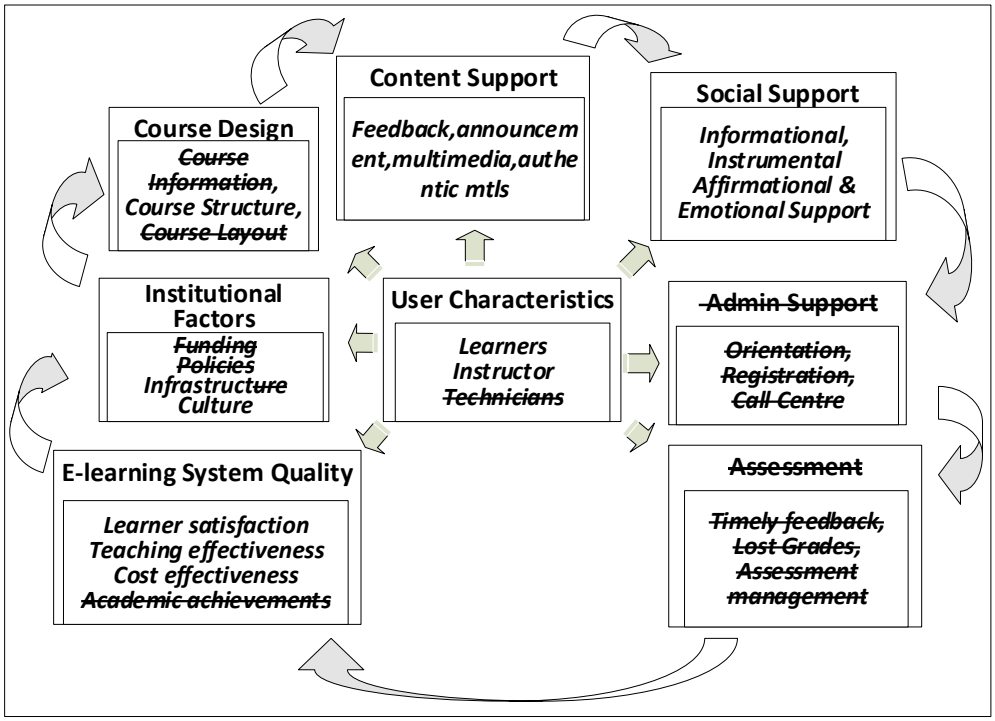

Figure 11: Mapping EQF to Review Tool

2.7.7 TMLE Evaluation Framework

The Technology Mediated Learning Evaluation Framework (TMLE) by Omwenga & Rodriguez, (2006) proposes that any mediation for educational purposes has a structure, a process and an outcome (SPO) which can be applied at three main levels: that of the technical system functioning, the human perspectives of those involved, and the overall impact on the education system (see figure 12). Technical aspects of a system fall most directly under structure, human perspectives fall under process and the education system falls under outcome. The summary of the framework is shown in figure 12.

Factors	Structure	Process	outcome
System functionality	What Hardware & software requirements are needed?	What Instructional methods are used?	Have learning Specifications been met?
Human Perspective(instructor)	What are the necessary changes in e.g. in skills, working conditions?	Has the user's mode of operation changed?	Has the user become more effective?
Human Perspective(Learner)	Behavior modification	Is there a Change of learner experience?	Does the use of the system result in changes in the quality of service and better education for the recipient?
Human Perspective (the administrator)	Is the system a reasonable, cost-effective and efficient alternative to existing structures?	Does it change the character of the administrator's job?	Does the system improve specific education provision on a reasonable metric?
Education System	Does it change the balance between the functions of the different education providers?	Does it affect practice and delivered quality of education provision?	Does it improve the education status and development potential of the population it serves?

Figure 12: TMLE Evaluation Framework (Source: Omwenga & Rodriguez, 2006)

The TMLE framework can be seen to be primarily concerned with the human elements like skills, learners experience and the behavior modification for the users and the system functionalities like availability of hardware and software. The TMLE does however look at some of the educational aspects like learning improvement and cost-effective education.

2.7.8 Mapping TMLE Framework to Review Tool

The mapping of the TMLE shows full support for only one construct, institutional factors with indicators: funding and policies, culture and infrastructure. The others, partially supported are: user factors with instructor and technician characteristic; e-learning system with teaching

effectiveness and cost effectiveness. The unsupported indicators included Course structure, course information, course organization, course layout, technician characterictics, user satisfaction, multimedia, authentic materials, chat, forum, group work, grade management, orientation, advice, call center, registration, academic achievements and user satisfaction. The mapping for the TMLE model is represented in Figure 13.

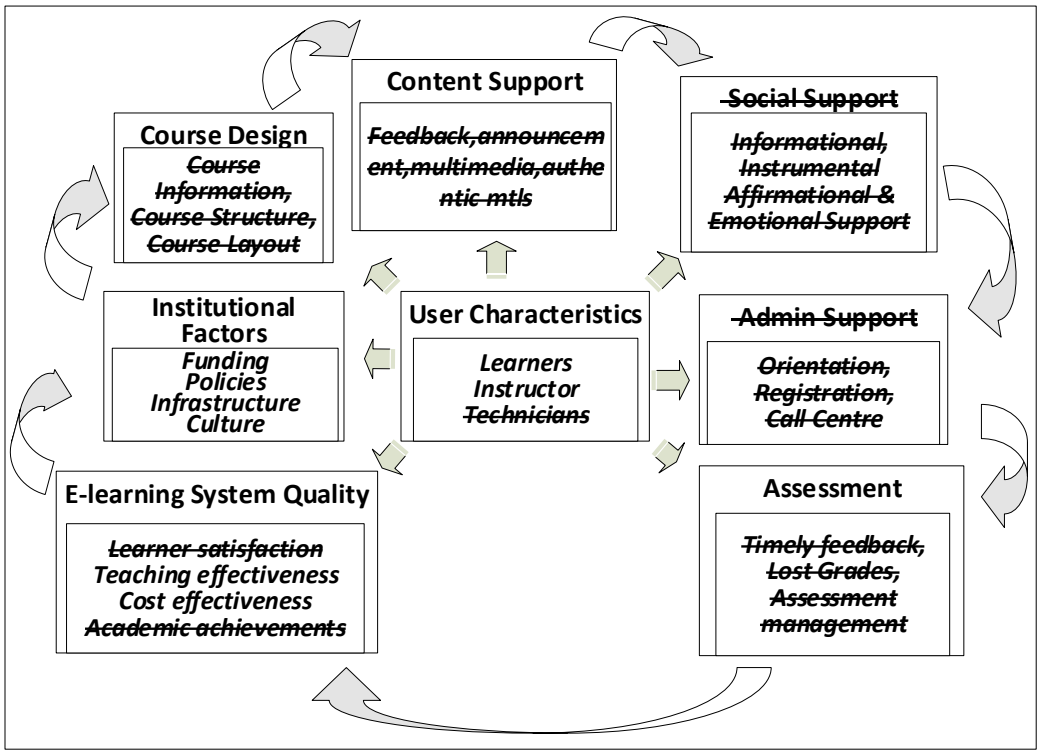

Figure 13: Mapping TMLE Framework to Review Tool

2.7.9 E-Learning Maturity Model (EMM)

The EMM takes the ideas of process capability maturity and uses them as a foundation for a form of benchmarking explicitly intended to improve the quality of e-learning for the benefit of students, staff and institutions. Since its initial conception (Marshall & Mitchell, 2002), the EMM has evolved from version 1 to version 2 which makes it more usable by institutions and researchers conducting their own assessments. The EMM divides the capability of institutions to sustain and deliver e-learning into six major categories or process areas: learning, development, co-ordination, organization and optimization (see figure 14).

Learning	Processes that directly impact on pedagogical aspects of e-Learning
Development	Processes surrounding the creation, support and maintenance of e-Learning resources.
Co-ordination	Processes surrounding the oversight and management of e-Learning
Evaluation	Processes surrounding the evaluation and quality control of e-learning through its entire lifecycle.
Organization	Processes associated with institutional planning and management.
Optimizing	Continual improvement in all aspects of the e-Learning process

Figure 14: e-Learning Maturity Model.
Source (Marshall, 2002Marshall, 2006)

2.7.10 Mapping EMM to Review Tool

The mapping of the EMM shows full support for only one construct, institutional factors with indicators: funding and policies, culture and infrastructure. The only partially supported construct is user factors with learner and instructor characteristic. The unsupported indicators include teaching effectiveness, user satisfaction, academic achievements, Cost Effectiveness, Course structure, course information, course organization, course layout, technician characterictics, multimedia, authentic materials, chat, forum, group work, grade management, Orientation, Academic Advice, Call Center and Registration. The mapping for the EMM model is represented in Figure 15.

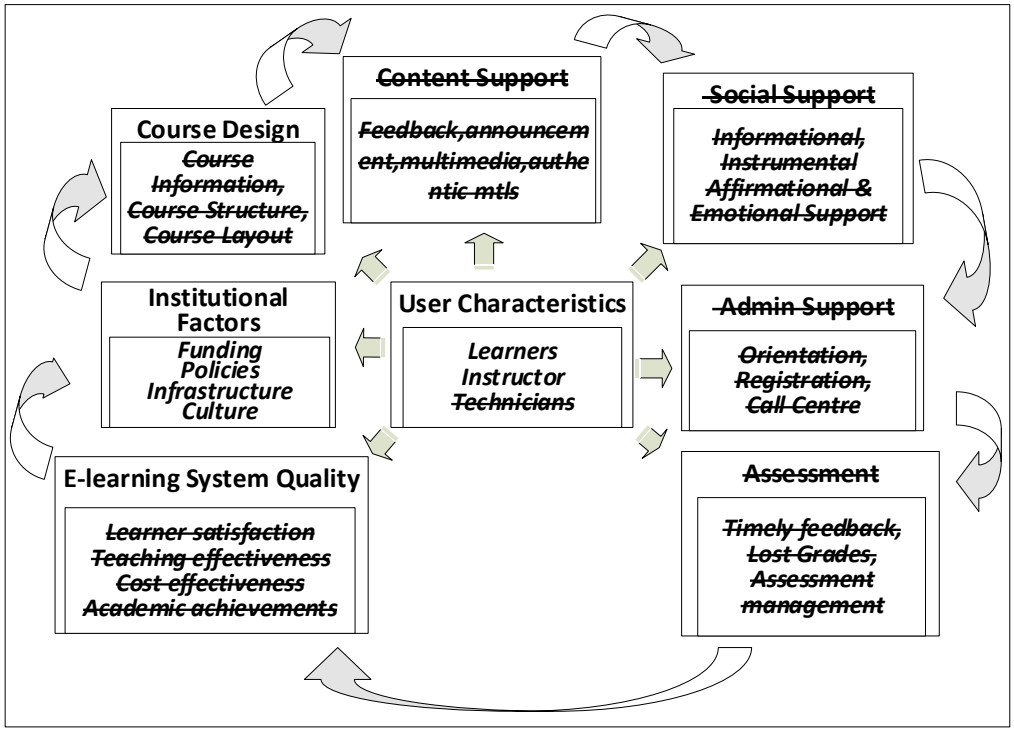

Figure 15: Mapping EMM model to Review Tool

The mappings of all the five frameworks and models are summarized in table 9. The table shows the factors for each framework or model in terms of Strengths/Contribution and Weaknesses. The strengths show the factors owned by the model or framework that are relevant for HEI e-learning systems. The weakness represents the important factors that are missing from the models and frameworks yet they are required for e-learning. Both set of factors were used in the derived e-learning evaluation model.

Table 9: Models/Frameworks Strengths & Weaknesses.

Model/ Framework	Strengths(Contributions)	Weaknesses
P3(Khan, 2004)	Planning, Design, Production, Evaluation, Delivery and Maintenance, Instruction stage	Infrastructure, culture, Course Layout, Learners characteristics, Cost effectiveness Academic achievements, user satisfaction, authenticity of content
PDPP (Zhang & Cheng, 2012)	Overall Evaluation, funding, planning, assignment, examination, course design, technical support, user satisfaction, learning effectiveness	Course Structure, multimedia, examinations, assignments, Learners characteristics Instructor characteristics, user satisfaction, Teaching effectiveness. Funding
EQF (Masoumi & Lindstrom, 2012)	Technological, Instructional Design, Faculty Support, Student Support, Evaluation, Pedagogical.	Funding, Policies, culture, course information, course structure, course organization, technician characteristics, assessment academic achievement
TMLE (Omwenga & Rodriguez, 2006)	Funding, Policies, Infrastructure, admin support, Instructional methods, Hardware & software requirements, Quality of service, learning specifications, user skills, better education, effective learning	Course information, course structure, course organization, , content support, social support, assessment, user satisfaction
EMM (Marshall, 2002Marshall, 2006)	Processes surrounding the creation, support and maintenance of e-Learning resources, the evaluation and quality, institutional planning and management.	Course development constructs, learner support constructs, assessment and overall performance constructs

2.8 Proposed Research Model

As discussed in the previous section, the derivation of the research model followed a detailed approach where information acquired through literature review was jointly blended with insights from a qualitative pre-study to construct a review tool. The review tool was used to assess the existing models and frameworks of quality evaluation with the view of creating a comprehensive model of evaluation. It is appropriate to point out at this stage that the proposed model is an improvement of the existing models and frameworks as it is composed of new factors that the models/frameworks did not have. The model is presented in figure 16.

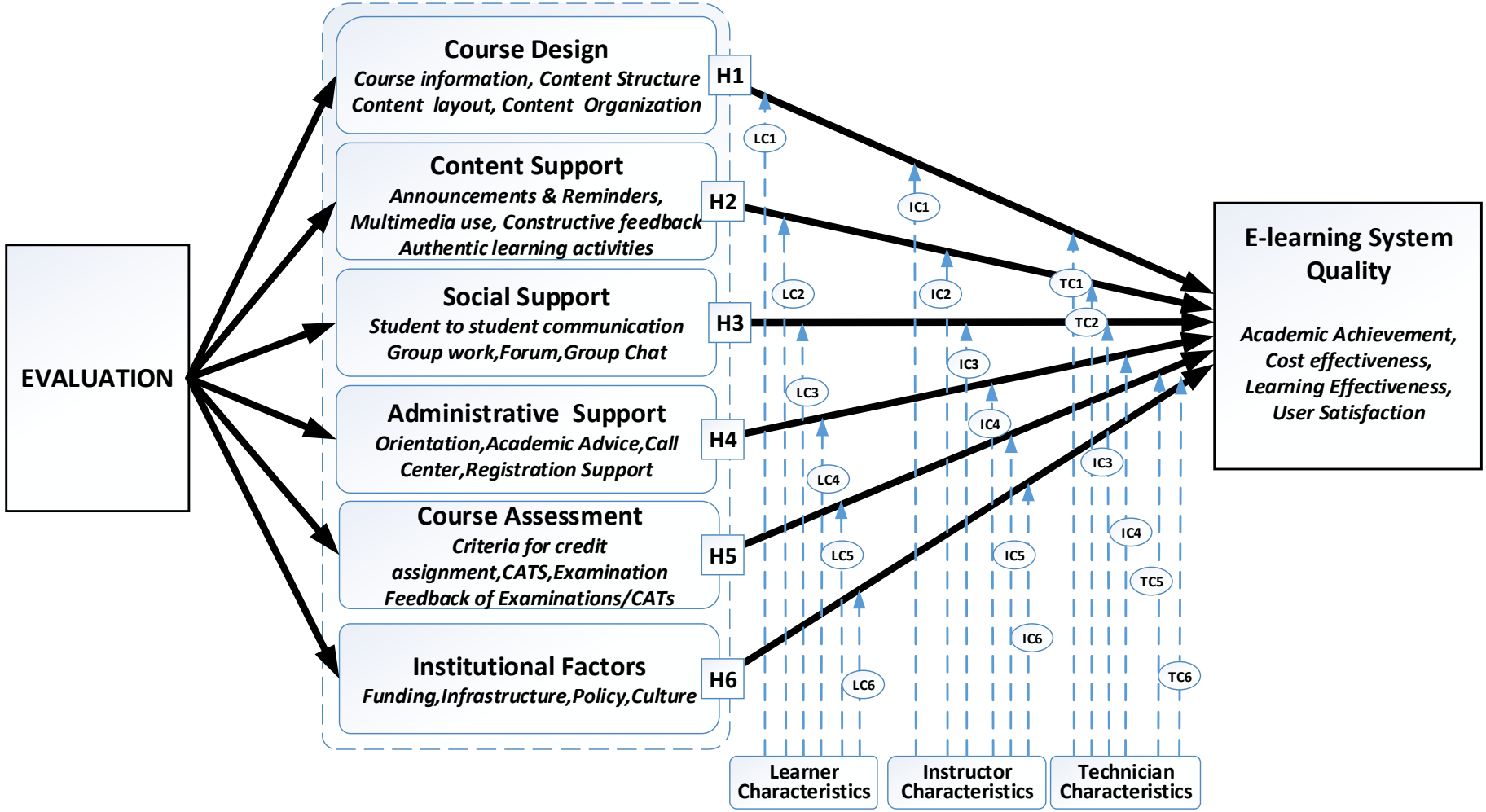

Figure 16: Proposed e-learning Quality Evaluation Model

2.8.2 The Hypotheses

In essence, 12 hypotheses and 24 sub hypotheses are formed. This will be tested using empirical data from JKUAT.

Hypothesis 1

H_1: Course Design factors significantly affect e-learning system quality.

- $H_{1.1}$: Course information significantly affects course development.
- $H_{1.2}$: Content structure significantly affects course development.
- $H_{1.3}$: Course Layout significantly affects course development.
- $H_{1.4}$: Course Organization significantly affects course development.

Hypothesis 2

H_2: Content Support significantly affects e-learning system quality.

- $H_{2.1}$: Announcements & reminders significantly affect content support.
- $H_{2.2}$: Use of multimedia significantly affects content support
- $H_{2.3}$: Constructive feedback significantly affects content support.
- $H_{2.4}$: Authentic learning activities significantly affect content support.

Hypothesis 3

H_3: Social Support significantly affects e-learning system quality.

- $H_{3.1}$: Informational Support significantly affects social support.
- $H_{3.2}$: Instrumental Support significantly affects content support
- $H_{3.3}$: Affirmation support significantly affects content support.
- $H_{3.4}$: Emotional Support significantly affects content support.

Hypothesis 4

H_4: Administrative support significantly affects e-learning system quality.

- $H_{4.1}$: Campus Orientation significantly affects admin support.
- $H_{4.2}$: course registration support significantly affects admin support.
- $H_{4.3}$: Academic Advice significantly affects admin support.
- $H_{4.4}$: Departmental call center significantly affects admin support.

Hypothesis 5

H_3: Course Assessment significantly affects e-learning quality.

- $H_{5.1}$: Lost Grades significantly affect Assessment Quality (CA1).
- $H_{5.2}$: Better assignment management significantly affects Assessment Quality (CA2).
- $H_{5.3}$: Assessment feedback significantly affects Assessment Quality (CA3).
- $H_{5.4}$: Course Content significantly affects Assessment Quality CA4).

Hypothesis 6

H_6: e-learning Institutional Factors significantly affect e-learning quality.

- $H_{6.1}$: Funding significantly affect e-learning quality.
- $H_{6.2}$: Infrastructure factors significantly affect e-learning quality.
- $H_{6.3}$: Policy factor significantly affects e-learning quality.
- $H_{6.4}$: E-learning culture significantly affects e-learning quality.

The hypotheses for moderating factors on this relationship were as follows:

H_7: The effect of Course Design on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_8: The effect of content support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_9: The effect of Social Support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{10}: The effect of Administrative Support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{11}: The effect of Course Assessment on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{12}: The effect of Institutional Factors on e-learning system quality is moderated by learner, instructor and technician characteristics.

CHAPTER THREE-RESEARCH METHODOLGY

3.1 Introduction

Research methodology is the systematic way for doing research. The methodology used in the study consisted of a Pragmatism philosophy because pragmatism advocates the use of mixed methods in research. The study also employed a cross sectional study as the data was collected at once in a survey of 180 respondents from JKUAT. The data was analyzed via Structural Equation Modeling (SEM) and Regression Analysis after being collected by Questionnaires and Interviews

3.2 Research Philosophy

A research philosophy is a belief about the way in which data about a phenomenon should be gathered, analyzed and used in order to develop knowledge (Burns and Grove, 2003). The 'research onion' developed by Saunders et al. (2012) was used in developing the research process for the study (Figure 17).

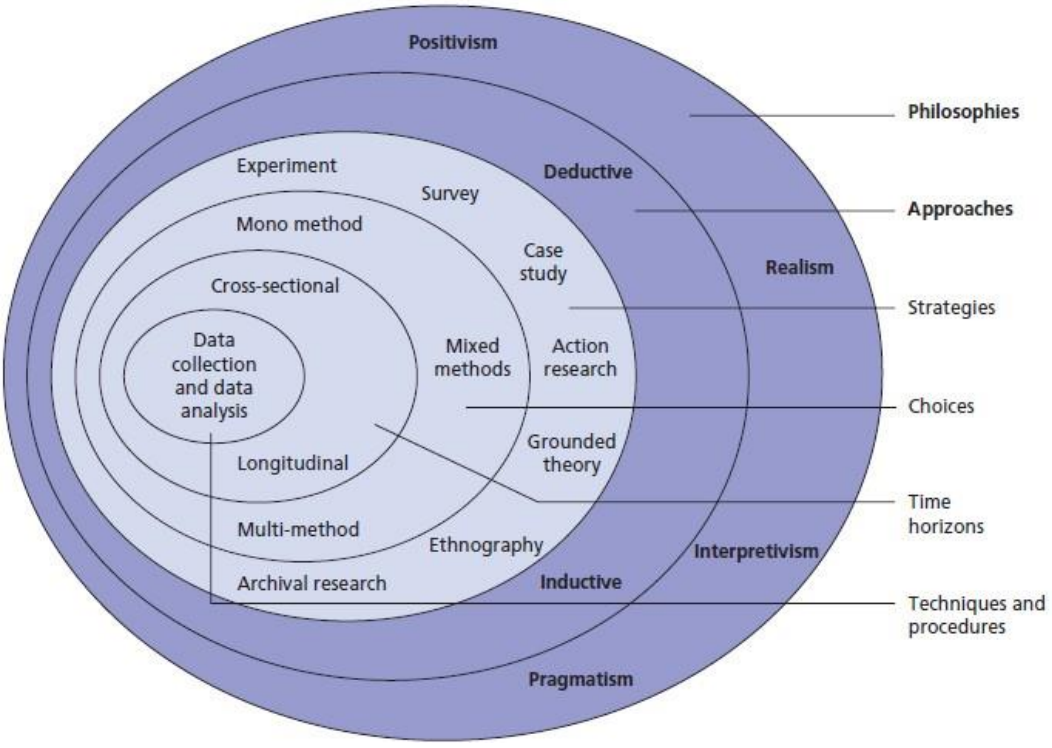

Figure 17: Research Philosophy
Source :(Saunders et al., 2012)

The Research onion (RO) consists of Research Philosophy, Research Approaches, Research Strategy, Choices, Time Horizons, Data Collection and Analysis, Research Design and Sampling Technique. The identification of the research philosophy is positioned at the outer layer of the 'research onion'. The four main research philosophies are pragmatism, positivism, realism and interpretivism.

3.2.1 Pragmatism

Saunders et al. (2012) posits that Pragmatics recognize that there are many different ways of interpreting the world and undertaking research and that no single point of view can ever give the entire picture and that there may be multiple realities. A pragmatic philosophy also uses both inductive and deductive approaches to create a theory or to confirm a hypothesis, and can work with both descriptive and exploratory research. Furthermore, pragmatism works with both qualitative and quantitative data. Pragmatism philosophy was selected because it is compatible with the study research design.

3.3 Research Design

Saunders et al.(2012) describes research design as a general plan about what needs to be done to answer the research questions. Research design for the study was descriptive and exploratory in nature because of the need to exhaustively describe factors influencing e-learning quality(Kothari, 2004). A cross-sectional survey was used instead of a longitudinal survey because the study was designed to collect data at a single point in time rather than conduct several observations of the same subjects over a period.

3.3.1 Research Strategy

The strategy used in the study started with a systematic literature review followed by a qualitative pre-study to determine the factors that determine quality. A case study strategy was used by surveying 180 JKUAT students, instructors and technicians using questionnaires and interviews to collect data (Bryman, 2012). The researcher chose a survey research design because of ease of administration and duration taken to answer the study objectives and purpose. The survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group.

3.3.2 Sampling Technique

A sample is a representative segment of a larger population (Bryman, 2012). In quantitative research, the sample size and how it is selected can be used to establish the reliability of the results of the study. In qualitative research, the sample characteristics are also important although much smaller samples tend to be used. The sample size represents the number of respondents selected from the overall population in the research (Newman, 1998).

Sampling techniques are the ways in which an appropriate sample size are selected for the wider study (Bryman, 2012). Sampling can be simplified, random or stratified. A random sample represents individuals within a larger population chosen at random. However, this can result in random distribution, which can mean significant skewing resulting from the random nature of sample selection (Neuman, 2003). Stratified sampling was used to ensure the representatives of the population in the sample reflect the significant characteristics of the wider population, such as making sure that the demographic characteristics of age and gender are reflected (Newman, 1998).

3.3.3 Sample Size

The study was done at JKUAT main campus between 2nd December to 20th December, 2016 at SODEL center. The center has three intakes in any given academic year: January, May and September. Candidates are admitted from Certificate, Diploma, Bachelor, and Postgraduate programmes. Although the current e-learning student enrolment stands at about 700 students, the study targeted the postgraduate students only totaling 315.

The rest consisted of, instructors (29), the technicians (5) and the e-learning director (1). The total target population was 350. According to Kline (2005), SEM studies should use a sample size between 100 and 200. By using Kjericie & Morgan's (1970) sample size table based on 95% confidence level, a population of 350 yields a sample size of 180. The sample size (180) being a high value was considered sufficient to minimize type I (false positive) and type II (false negative) errors (Banerjee et. al, 2009). Stratified sampling was used to obtain 180 respondents from the total population of 350 by creating eleven strata's as presented in table 10.

Table 10: Target Enrolment and Sample Size

SN	Strata	Enrolment	Sample Size
1	Msc. in Leadership and Governance	50	50/350*180=25
2	Msc in Procument and Logistics Management	45	45/350*180=22
4	Msc in Business Administration	60	60/350*180=30
5	Msc in Project Management	50	50/350*180=25
6	Msc in Human strategic management	40	40/350*180=21
7	Msc in entrepreneurship	40	40/350*180=21
8	Msc in IT	30	30/350*180=17
9	instructors	29	40/350*180=16
10	Technicians	5	5/350*180=3
11	E-learning deputy director	1	1/350*180=1
12	**Total**	**350**	**180**

3.3.4 Data Collection Methods

The study identified ten (10) constructs that guided data collection. Hair et al. (2010) and Kline (2011) recommends at least three indicators (observed variables) to measure each of the constructs. Kothari (2004) added that data could be collected via email survey, telephone survey, questionnaire or personal interview. Based on this insight, questionnaires and interviews were used because of ease of administration with each construct having a minimum of three indicators. All the instruments used in the study are attached as appendix A.

The instruments consisted of student's questionnaire, instructor questionnaire, student interview theme, instructor interview theme and technician interview theme. The questionnaire had three main sections. Section 1 was used to collect bio-data such as gender, level of education and general guidelines. Section 2 was designed to collect data on the ten (10) identified

constructs of the study. The respondents' perceptions were gauged on the various indicators associated with the particular construct. The last section of the questionnaire was used to collect qualitative data about the study.

3.3.5 Piloting

In order to ensure that the questions in the instruments were consistent and that all the relevant issues relating to the study were covered, a pilot study consisting of 22 respondents (15 male students, 5 female students and 2 e-learning instructors) was conducted at EGERTON University e-learning center. Both instruments were tested on a small number of respondents who are the same type as those tested later in JKUAT.

3.3.6 Data Collection Procedure

The instruments were hand delivered to the students and their instructors during the end semester examinations conducted between 2nd -9th December 2016. Data agents were used to coordinate distribute and collect the data within a period of two weeks. There were eight (8) interviews with each taking roughly 40 minutes to conduct and record. Both the quantitative and the qualitative data were coded as numbers between 1 and 5 representing a Likert scale of 1 to 5 (1 –Strongly disagree; 2 –Disagree; 3 –Neutral; 4 – Agree and 5 – Strongly Agree). The qualitative data was initially put into themes and categories to obtain inferences that relate to the study objectives (Patton, 2002).

3.3.7 Hypothesis Testing

To test the hypothesis and moderation effects, Structural Equation Modeling (SEM) and Regression Analysis were used. SEM has become an important and widely used research tool for theory testing and development in the social sciences as well as in IS research to examine technology adoption, acceptance, and success in and organizations(Gallagher, Ting, & Palmer, 2008; Urbach and Ahlemann, 2010). Regression Analysis on the other hand is the most suited method for testing moderation effects. Since the study aimed at developing hypotheses upon a pre-existing theory, deductive approach was used. By generalizing the findings to suit other context, inductive approach was used (Silverman, 2013; Bryman & Bell, 2011). Figure 18 illustrates the overall research design.

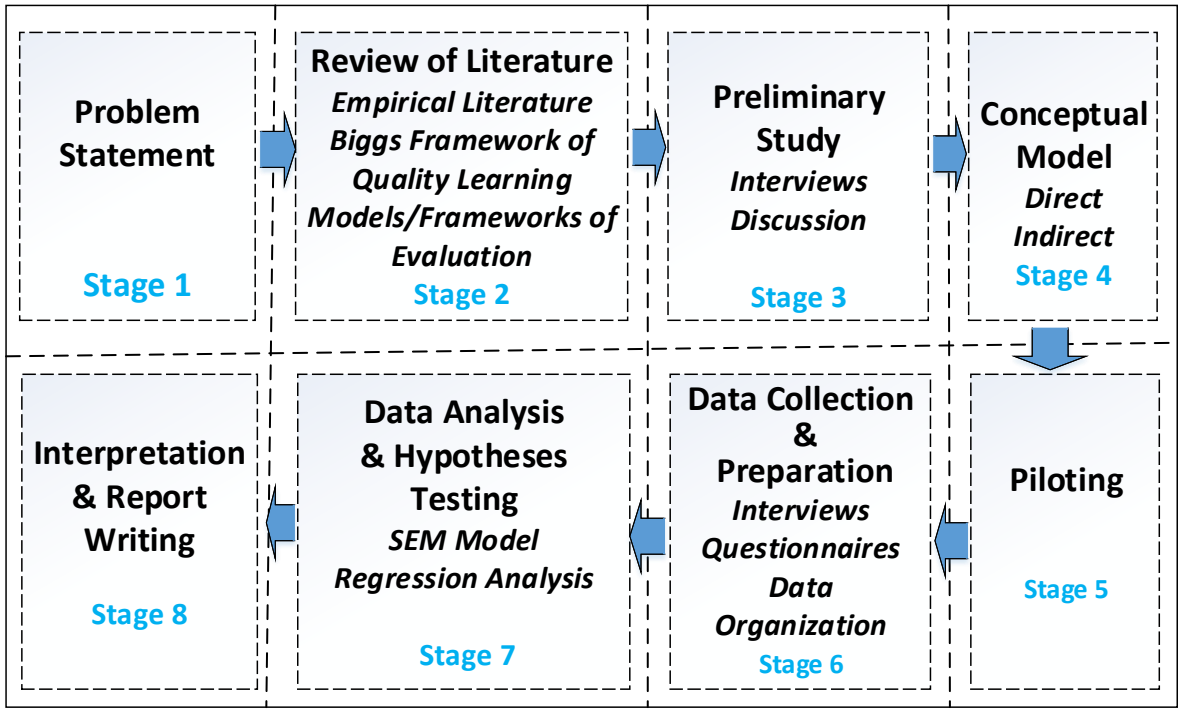

Figure 18: Overall Research Design
Adopted from Kothari (2004).

3.4 Merits of using SEM

SEM offers diverse merits in data analysis compared to other Analysis techniques in several areas. These are summarized in table 11.

Table 11: Merits of SEM

	SEM	Traditional Methods
1	Multivariate technique incorporating observed (measured) and unobserved variables (latent constructs) allow simultaneous analysis of all the variables in the model instead of separately	Simultaneous evaluation of model construct relationships is not possible; evaluation has to be performed in sequential steps.
2	Requires formal specification of a model to be estimated and tested.	Specify a default model whereas
3	Allows researchers to recognize the imperfect nature of their measures by explicitly specifying error while traditional methods assume measurement occurs without error.	No error specification
4	Provides no straightforward tests to determine model fit. Instead, the best strategy for evaluating model fit is to examine multiple tests (e.g., chi-square, Comparative Fit Index (CFI), Root Mean Squared Error of Approximation (RMSEA).	Provides straightforward significance tests to determine relationships between variables or the amount of variance explained
5	A graphical language such as AMOS or smart PLS provides a convenient and powerful way to present complex relationships in SEM.	No graphical interface
6	Multicollinearity cannot occur because unobserved variables represent distinct latent constructs.	Multicollinearity may occur

3.5 Suitability of CB-SEM over PLS-SEM

Researchers applying SEM can choose between a covariance base analysis (CB-SEM) and variance based approach, known as partial least squares (PLS-SEM). Gefen et al. (2000) and Hair et al.(2012b) argues that each approach has different assumptions and aims. Hair et al.(2012a) observed that the CB-SEM approach aims at reproducing the theoretical covariance matrix,

without focusing on explained variance, while PLS-SEM aims at maximizing the explained variance of the dependent constructs. Hair et al. (2011) added that PLS-SEM works well with non-normally distributed data while CB-SEM prefers normally distributed data.

The study employed CB-SEM approach for testing the hypotheses because it accommodates large sample sizes of normally distributed data and most importantly, it correctly specifies the model. Although there are a number of SEM packages available to researchers, SPSS-AMOS, smartPLS, Mplus and EQS. The decision on which package to use is largely based upon personal preference, with all the packages having their own comparative advantages and disadvantages. The study made a preference for use of AMOS due to its relative ease of use, ease of modification, no need to calculate covariance matrices and its close ties with the SPSS package (Gallagher, Ting, & Palmer, 2008).

3.6 Modeling in SEM

According to Wong (2013), SEM technique uses two sub models: the inner model, which specifies the relationships between the independent and dependent latent variables and the outer model, which specifies the relationships between the latent variables and their observed indicators. SEM also uses two variable types: exogenous and endogenous. An exogenous variable has path arrows pointing outwards and none leading to it, while an endogenous variable has at least one path leading to it and represents the effects of other variable(s).

Kaplan (2000) and Rex (2011) said that SEM can be used to invoke a measurement model that defines latent variables using one or more observed variables, and a structural model that imputes relationships between latent variables. The study conceptual model was modelled using SEM modelling having one inner model and two outer models, six exogenous variables and one endogenous variable and twenty-two (22) indicators. The model is presented in figure 19. The moderator variables do appear in the diagram as they were analyzed separately using Regression Analysis.

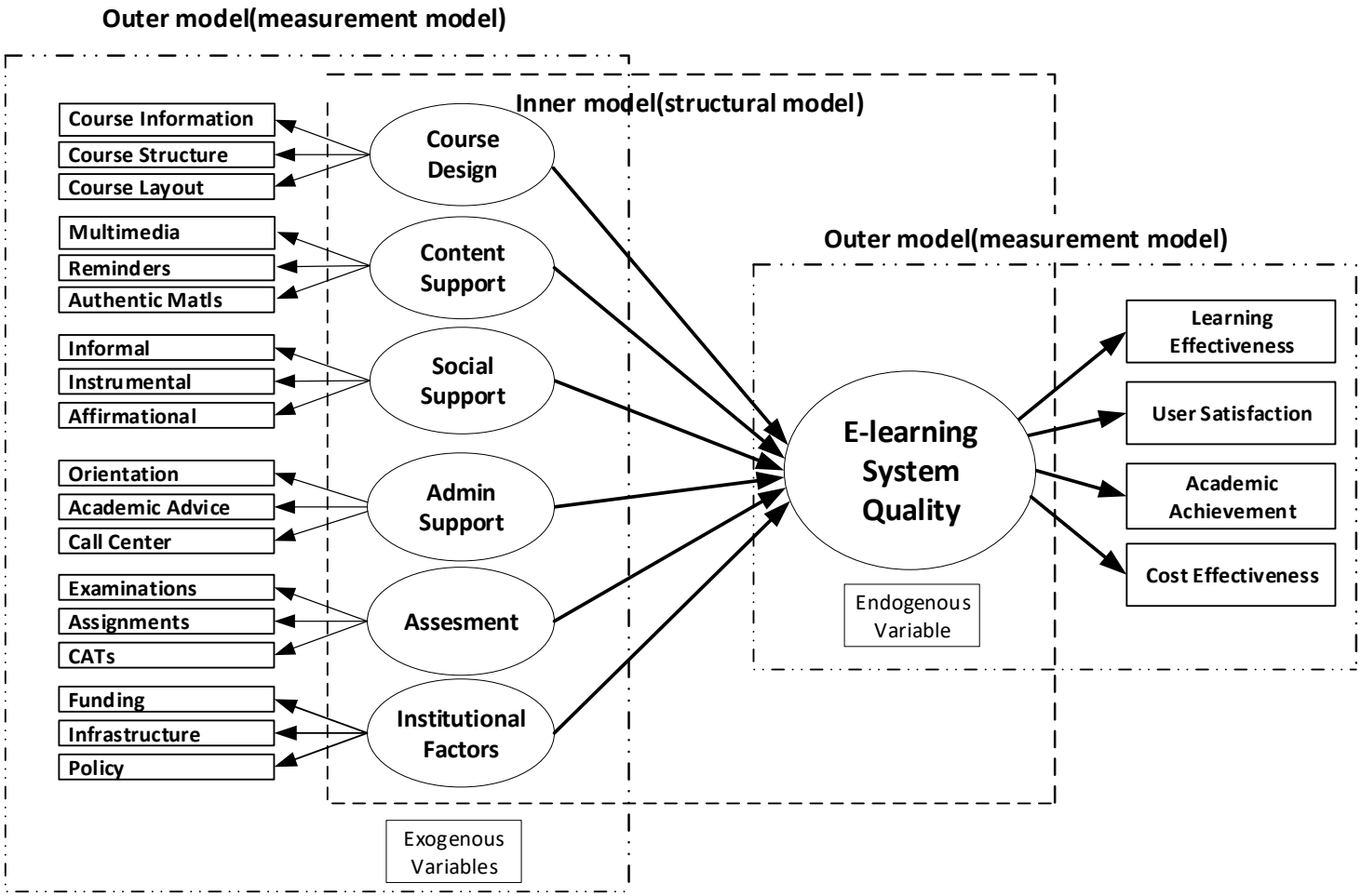

Figure 19: SEM Modeling Technique
Source (Adopted from Wong, 2013)

3.6.1 Data Organization in SEM

Data organization includes all the processes that screen and test the data for any problems prior to conducting SEM model analysis (Kline, 2011). Other aspects involve identifying the sample size, measurement scale and the restriction of range in the data values. Screening and testing for missing data, outliers, nonlinearity, and non-normality of data were done using the built-in menu options in SPSS. The following section describes how these aspects were achieved in details.

a) **Missing Data**

The statistical analysis of data is affected by missing data values in variables. That is, not every subject has an actual value for every variable in the dataset, as some values can go missing. It is common practice in statistical packages to have default values for handling missing values. Kline (2011) and Hair et al. (2010) observed that the various SEM software handle missing data differently and have different options for replacing missing data values such as deleting subjects with missing data on any variable, deleting subjects with missing data on each pair of variables used or substituting the mean for missing values of a variable. Fortunately, no missing data were found in the study so no observations were eliminated.

b) Outliers

Outliers in statistical analyses are extreme values that do not seem to fit with the majority of a data set. If not removed, these extreme values can have a large effect on any conclusions that might be drawn from the data in question. Outliers can be caused by observation errors, data entry errors, instrument errors based on layout or instructions, or actual extreme values from self-report data (Kline, 2011 &Hair et al., 2010). Outliers were removed in SPSS by using the Explore function to find extreme scores (Analyze, Descriptive Stats, and Explore). This produced a Stem-and-Leaf Plot and Boxplot used to find outliers. By enlarging and taking note of cases that lie beyond the black lines, (these are the outliers). A choice was made on whether to remove all of the outliers or only the extreme outliers, which were marked by a star (*). This was done by going back into the data file and locating the cases that needed to be erased.

c) Data Distribution

The study also checked whether the sample data chosen for the study was normally distributed. In a normal distribution, a bell-shaped density curve described by its mean and standard deviation is formed. Variables should have approximately but not exactly, normal distributions and the measures of central tendency that is mean, median and mode should all fall in the central mid line. Standard deviations (SD) are used to measure variations existing in the distributions. Approximately 34% of the scores should fall between the mean and 1 SD. Approximately 68% of the scores should fall between 1 SD above and 1 SD below the mean. Approximately 95% of the scores should fall between 2 SD above and 2 SD below the mean. Approximately 99.7% of the scores should fall between 3 SD above and 3 SD below the mean. These descriptions are illustrated in figure 20.

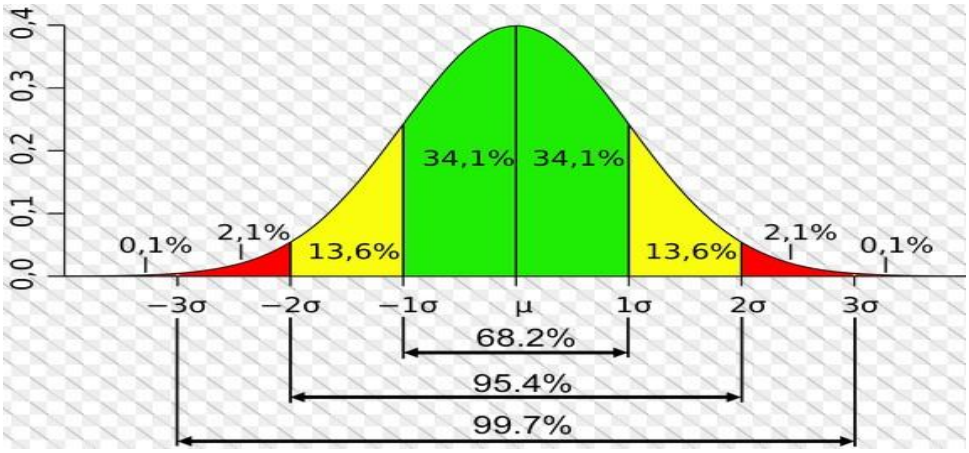

Figure 20: Normal Distribution Curve
Source: Google Images

d) Normality Testing

Normality tests are used to determine whether a data set is modeled for normal distribution or nearly normal distribution. The study used skewness and excess kurtosis to test the normality of the data. The skewness value can be positive or negative, or even undefined. If skewness is 0, the data are perfectly symmetrical, if skewness is less than -1 or greater than 1, the distribution is highly skewed. If skewness is between -1 and -0.5 or between 0.5 and 1, the distribution is moderately skewed. If skewness is between -0.5 and 0.5, the distribution is approximately symmetric. West et al. (1996) proposed that for medium-sized samples (50 < n< 300), skewness

and kurtosis values of +/-2 and +/-4 at 0.05 significance respectively may be used as reference values for determining substantial non-normality.

e) Data Linearity

SEM assumes that the variables are linearly related to one another. Thus, a standard practice is to visualize the coordinate pairs of data points of two continuous variables by plotting the data in a scatterplot. These bivariate plots depict whether the data are linearly increasing or decreasing. The presence of curvilinear data reduces the magnitude of the Pearson correlation coefficient, even resulting in the presence of a zero correlation. Nonlinearity of the data was checked by using scatterplots with no outliers being detected.

3.7 Instrument Assessment

Once all the data had been coded into the SPSS software, the instrument was assessed to check whether it exhibited adequate reliability and validity. Hair et al. (2010) observed that Reliability test done to verify internal consistency should be measured using cronchbach alpha with a threshold minimum of 0.7. Validity test was done using construct validity (CV). CV was measured using factor loading threshold minimum of 0.4, Average variance extracted (AVE) threshold minimum of 0.5 and composite reliability (CR) threshold minimum of 0.7(Fornell and Larcker, 1981).

3.8 Data Analysis using SEM

The next step after data preparation and assessment instrument was the analysis stage using ding blocks of SEM analysis according to Kline (2011) follows a logical sequence of six steps or processes: (1) model specification, (2) model identification, (3) model estimation, (4) model testing, (5) model modification and (6) report results. These steps are actually iterative because problems at a later step may require a return to an earlier step. The revised flowchart of the steps is presented in Figure 21.

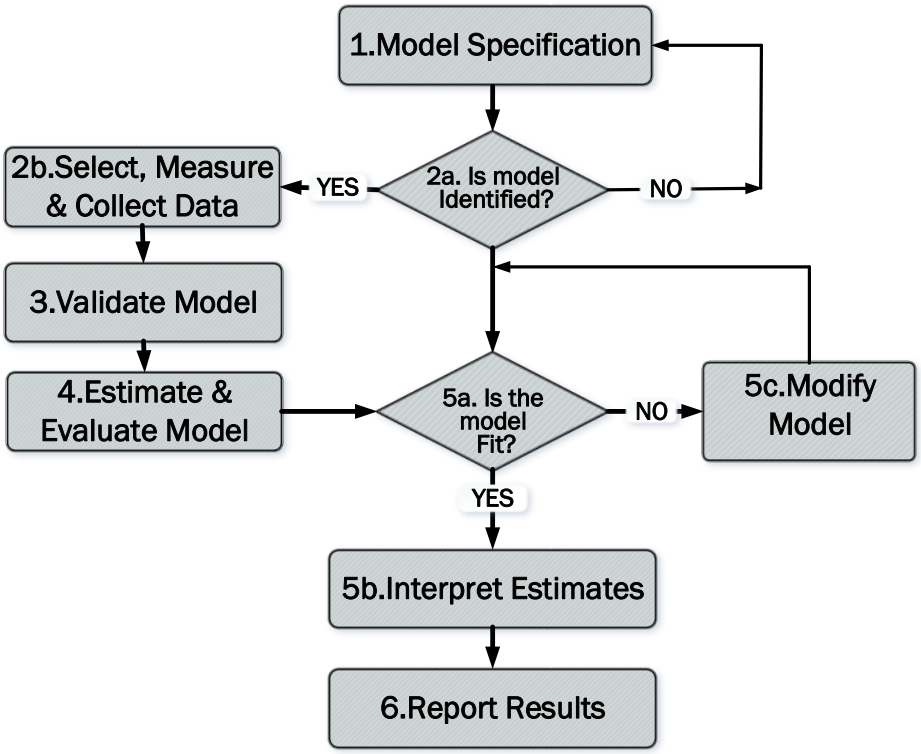

Figure 21: Flowchart of the basic steps of SEM.
Source: Adopted from (Kline, 2011)

3.8.1 Model Specification

Model specification involves using all of the available relevant theory, research, and information to develop a theoretical model. Thus, prior to any data collection or analysis, the researcher specifies a particular model that should be confirmed using variance–covariance data. In other words, available information is used to decide which variables to include in the theoretical model (which implicitly also involves which variables not to include in the model) and how these variables are related. Model specification involves determining every relationship and parameter in the model that is of interest to the researcher.

3.8.2 Model Identification

Model identification is normally determined by the degrees of freedom (DF) of the model; where the degree of freedom is the total sample moments less the parameters to be estimated. A negative degree of freedom indicates that the model is *under-identified*; a positive value indicates that it is over-identified and a model with zero value means it is *just identified*. An over identified model makes it possible for the analysis software to run and test your hypotheses, which can then be evaluated using the chi-square statistic of absolute model fit and various descriptive

model fit indices For measurement models, the "Three Measure Rule" states that a congeneric measurement model will be identified if every latent construct is associated with at least 3 measures according to Davis (1993) and Reilly (1995). SEM software programs such as AMOS perform identification checks as part of the model fitting process (Kline, 2011; Hair et.al, 2010).

3.8.3 Model Estimation

The goal of model estimation is therefore to minimize the differences between the observed and the implied covariance matrices (finding parameter estimates that minimize a badness-of-fit). According to Hair et al. (2010), the hypotheses of a sample of <= 200 can be tested by using the Maximum likelihood estimation method with observed factor loadings >0.4(The standardized regression) and probability significance levels of <= 0.05.

3.8.4 Model Evaluation

Once the parameter estimates are obtained for a specified SEM model, the researcher should determine how well the data fit the model that is to what extent the theoretical model is supported by the obtained sample data. The goodness of fit of a statistical model describes how well it fits a set of observations. However, Bentler (1990)cautions that the chi-squares ($\chi 2$) statistic is highly sensitive to sample size to the extent that tests involving large samples (sample size.>=200), would generally lead to a rejection of the null hypothesis even if the factor model is appropriate.

Thus, in the study, the Goodness-of-Fit-Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI) Root Mean Square Error of Approximation (RMSEA) were used (Bentler, 1990). The recommended minimum thresholds for GFI, CFI & NFI should be 0.95 with an RMSEA value of .08. These values should not be cast in stone as some models may not quite obtain them.

3.8.5 Model Modification.

Given the complexity of structural equation modelling, it is not uncommon to find that the fit of a proposed model is poor, necessitating the modification of the model and subsequently evaluating the new modified model. The goal is to improve model fit that is changing the model to fit the data. The modifications must be theoretically consistent and must

be replicated with new data. Chou (2002) and Hooper (2008) proposed that model modification could be achieved by: releasing constraints (adding free parameters), imposing constraints (deleting free parameters), use of modification indices (MI), correlating error terms and adding links between items.

3.8.6 Two Tailed and One Tailed Test

Two different methods can be used for testing hypotheses. The P-value Method (One Tailed) and the Traditional method - Using Rejection Regions (critical value approach or two tailed). To use a P-value to make a conclusion in a hypothesis test, compare the P-value with α. If $P \leq \alpha$, then reject H_0. If $P > \alpha$, then fail to reject H_0. The rejection region (critical region) of the sampling distribution is the range of values for which the null hypothesis is not probable. If a test statistic falls in this region, the null hypothesis is rejected. A critical value Z_0 separates the rejection region from the non-rejection region.

Estimation of path coefficients is an important element of empirical investigations employing CB-SEM, since it provides the basis for hypothesis testing. Often each path coefficient will refer to a hypothesis, with each hypothesis being tested through the calculation of a P value associated with the path coefficient. In the frequentist framework of statistical significance, testing used in CB-SEM, if a P value is below a certain threshold then the corresponding hypothesis is assumed to be supported. The threshold is usually .05, used in conjunction with a one-tailed linear test of a directional hypothesis (Kock, 2016).

3.9 Moderator Analysis

The moderation model tests whether the prediction of a dependent variable, Y, from an independent variable, X, differs across levels of a third variable, Z. Moderator variables affect the strength and direction of the relation between a predictor and an outcome: enhancing, reducing, or changing the influence of the predictor (Aguinis, 2004; Jose, 2013). Moderation effects were tested with multiple regression analysis, where all predictor variables and their interaction term are centered prior to model estimation to improve interpretation of regression coefficients. A single regression equation forms the basic moderation model:

$$Y = i_5 + \beta_1 X + \beta_2 Z + \beta_3 XZ + e_5$$

Where β_1 is the coefficient relating the independent variable, X, to the outcome, Y, when Z = 0, β_2 is the coefficient relating the moderator variable, Z, to the outcome when X = 0, i_5 is the intercept in the equation, and e_5 is the residual in the equation. The regression coefficient for the interaction term, β_3, provides an estimate of the moderation effect. If β_3 is statistically different from zero, there is significant moderation of the X-Y relation in the data (Aguinis, 2004; Jose, 2013).

3.10 Summary of Research Methodology

The chapter has identified the research design to be a cross-sectional survey of 180 respondents using questionnaires and interviews with the data analysis using SEM and Regression Analysis and analysis tools being SPSS and SPSS-AMOS Version 21. Because of the availability of qualitative data, pragmatism philosophy was preferred. The chapter also identified the sampling technique as stratified and provided an insight on the SEM data organization techniques such as normality testing, instrument assessment and the procedures for conducting SEM and Regression Analysis.

CHAPTER FOUR-RESULTS AND FINDINGS

4.1 Introduction

This chapter presents the results and finding regarding the data analysis process conducted in the previous section. The chapter commences by giving the summary of the respondents in the study followed by an intricate descriptive statistics of the data collected based on the study variables. The chapter then discusses measurement and structural models that were obtained based on the proposed conceptual model. The output of the analysis steps stipulated by SEM as applied in the context of the study is also explained.

The measurement model was constructed, identified, estimated and then evaluated using various fit indices to determine whether the data fitted the model. This was done with the aim of making necessary modification to the measurement model if required as guided by theory. The structural model was also constructed and evaluated to determine whether to reject or accept the study hypotheses based on the measured thresholds provided by theory. This chapter eventually ends with a brief discussion of the results and findings based on quantitative and qualitative data collected for the study.

4.2 Summary of the Respondents

The total responses from questionnaires and interviews were **180.** This consisted of postgraduate students in Leadership and Governance, Procument and Logistics Management, Business Administration, Project Management, Human strategic management, entrepreneurship and IT totaling **160**. The rest totaling **20** included the instructors (16), technicians (3) and an administrator (1) who was the deputy director of e-learning. A sample size of 180 meets the threshold for conducting analysis in SEM studies and therefore provided the go ahead to start analysis. Table 12 summarizes the distribution of the sample by programme.

Table 12: Sample Distribution by Programme

Programme	Enrolment	Sample Size	Percent
Msc. in Leadership and Governance	50	25	14%
Msc in Procument and Logistics Management	45	22	12%
Msc in Business Administration	60	30	17%
Msc in Project Management	50	25	14%
Msc in Human strategic management	40	21	12%
Msc in entrepreneurship	40	21	12%
Msc in IT	30	17	9%
instructors	29	16	9%
Technicians	5	3	2%
E-learning deputy director	1	1	1%
Total	350	180	100

4.3 Descriptive Statistics

The study collected data about the status of e-learning system quality at JKUAT from a sample size of 180 'postgraduate' students who were on fully online. The rest consisted of instructors, technicians and an e-learning administrator.

4.3.1 Missing Data and Outliers

The default option used for checking for missing data in SPSS was: Analyze->descriptive statistics->Frequencies. Fortunately, no missing data was found so no observations were eliminated. For outliers, the procedure used to detect extreme scores was: Analyze, Descriptive Stats, Explore. For each of the 30 indicators, a Stem-and-Leaf Plot and Boxplot was obtained. Less than a third of the indicators (7) had extreme values representing 23% of the total indicators. These were erased from the data file.

4.3.2 Normality Testing Results

Based on the definitions of skewness and kurtosis, it is apparent that the distribution of the study depicted in table 11(see appendix B) is normal. Further evidence of normality is provided by figures 22 and 23, which portray the distribution of the Course Design and Content Support

variable indicators as near normal. These two variables are a representation of the distribution of several other variables in the study.

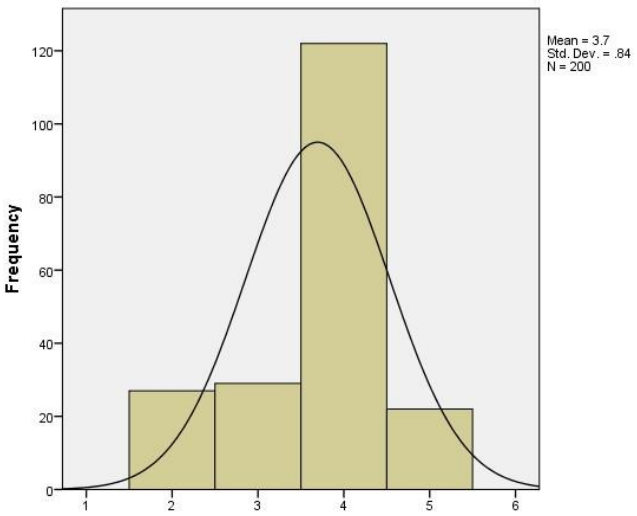

Figure 22:Normal Distribution of Course Design variable

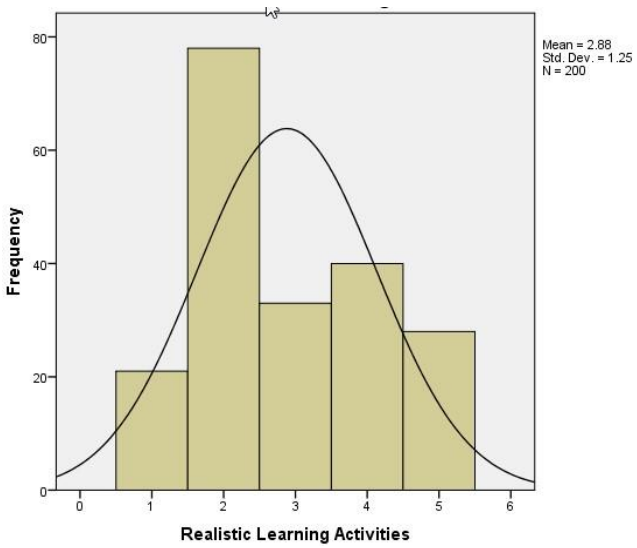

Figure 23:Normal Distribution of Content Support variable

4.3.3 Data Linearity Results

Three different sets of variables (dependent and independent) were tested at random to check for the existence of a linear relationship between them via a linear regression test. In each case, a scatter plot indicated a positive correlation between the variables proving that no curvilinear data existed. This proved that the data was linear.

4.3.4 Item Reliability Results

Before conducting analysis of the data, it was necessary to determine the reliability of the 134 measurement indicators in the questionnaire as a whole. This gave an alpha (α) value of 0.846. Since this value is higher than 0 .7, the items in the questionnaire can be considered to have a good internal consistency and are therefore reliable. Secondly, the reliability of the individual constructs was tested and each gave an alpha value greater than 0.7, again confirming the consistency of the constructs.

4.4 Status of e-learning System Quality

The status of e-leaning system quality as expressed by the respondents at JKUAT was obtained through frequencies from descriptive statistics based on the constructs and the indicators of the study. These results are shown in Tables 13-22.

4.4.1 Student Results

Table 13: Course design components that determine E-learning Quality

Course Design	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Course information	5(3%)	20(12%)	15(9%)	92(58%)	29(18%)
Course structure	9(6%)	88(54%)	14(9%)	18(11%)	32(20%)
Course layout	25(16%)	30(17%)	20(12%)	77(48%)	9(6%)
Course Organization	32(20%)	58(36%)	23(14%)	28(17%)	18(11%)

Number of respondents: (N = 180)

a) Course Design

The results on table 13 shows those over 54% of the students were happy with the course information provided and the course layout of the LMS. However, 60% did not like the course structure while 56% did not like the course organization.

Below are some of the comments from the students:

> "…although our content has no issues with spelling, grammar and accuracy, they rarely include more relevant examples to help us understand the subject. We always have to look for more materials to helps us understand better."

Table 14: Content Support Components that determine E-learning Quality

Content support	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Announcements provided	18(11%)	26(16%)	14(9%)	61(38%)	42(26%)
Reminders provided	11(7%)	81(25%)	26(16%)	56(35%)	27(17%)
Multimedia has been used	40(21%)	51(32%)	19(12%)	37(23%)	14(9%)
There is Constructive Feedback	37(23%)	53(33%)	23(14%)	31(19%)	17(11%)

Number of respondents: (N = 180)

b) Content Support

The results on table 14 shows those over 50% were happy about the provision of announcements and reminders through emails on their courses. However, over (53%) complained about lack of constructive feedback and inadequate use of multimedia. Below are some of the comments from respondents:

> "…the notes that our lectures upload are merely pdfs with without an inclusion of audio, video or animations. We normally download these pdfs and read them offline. Our lectures rarely pick our phones or reply our emails."

Table 15: Social Support Components that determine E-learning Quality

Social Support	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Information support from peers	39(24%)	53(33%)	13(8%)	27(17%)	29(18%)
Online library support (instrumental)	35(22%)	23(14%)	26(16%)	45(28%)	32(20%)
Emotional support from family & peers	47(29%)	52(32%)	22(14%)	26(16%)	14(9%)
Affirmational support by working in groups	34(21%)	60(37%)	18(11%)	36(22%)	13(8%)

Number of respondents: (N = 180)

c) Social Support

The results on table 15 shows that only instrumental support scored over (45%) implying the students heavily relied on online library for social support. The rest score below (40%) with information support (35%), emotional support (25%) and affirmation support (30%). Most of the students stressed that it was difficult to interact social as both the students and the instructors rarely used both the LMS course forum and chat. This is how one student commented.

"…we have just formed a's app group this week when we came for our semester examinations. Most of us are meeting for the first time. We hope for better interaction next semester through what's app group".

Table 16: Administrative Support Components that determine E-learning Quality

Admin Support	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Course Registration	9(5%)	32(20%)	21(13%)	70(44%)	29(18%)
Academic advice	18(11%)	27(17%)	23(14%)	60(37%)	33(21%)
Campus Orientation	11(7%)	26(16%)	29(18%)	55(34%)	40(25%)
Phone Call Support	38(24%)	50(31%)	24(15%)	31(19%)	18(11%)

Number of respondents: (N = 180)

d) Administrative Support

The results on table 16 shows that close to 60% of the students commended the support they got during on-campus orientation, course registration and academic advice they received when joining the course. However, 56% complained about the difficulties experienced when trying to make phone calls to the e-learning department at JKUAT. This was evident from the following response from a respondent:

"…imagine I had to travel all the way from Busia to Nairobi (a distance of 358km) to come and confirm my fee balance after I was told I could not sit for examinations yet I had cleared all my fees. I was told to come personally as I could not be assisted through phone calls".

Table 17: Course Assessment Components that determine E-learning Quality

Course Assignment	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Lost Grades	21(13%)	27(17%)	26(16%)	49(31%)	37(23%)
Assignment Management	15(9%)	32(20%)	24(15%)	58(36%)	32(20%)
Assessment & Feedback	22(14%)	40(25%)	23(14%)	42(26%)	34(21%)
Assessments & Content	42(26%)	20(12%)	17(11%)	50(31%)	32(20%)

Number of respondents: (N = 180)

e) Course Assessment

The results on table 17 show that 51% of the students agree that the content taught is enough to undertake assessments. Another 47% have no problem with lack assessment feedback such as CATs and assignments. Only 30% of the students supported claims that grade loss or misplacement was a problem in JKUAT, while 56% were satisfied with assignment management.

Table 18: Learner Characteristics components that determine e-learning Quality

Learner Characteristics	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
I enjoy using e-learning	29(18%)	47(29%)	19(12%)	48(30%)	18(11%)
Instructors motivate us	34(21%)	44(27%)	13(8%)	52(32%)	18(11%)
I have internet & computer experience	26(16%)	34(21%)	17(11%)	45(28%)	39(24%)
We have been trained on E-learning	37(23%)	50(31%)	21(13%)	40(25%)	13(9%)

Number of respondents: (N = 180)

f) Learner Characteristics

The results on table 18 shows that those who enjoy e-learning are 41% while those who don't are 47%. Majority (52%) also reported having useful internet and computer experience while over 50% lamented lacking LMS training as well lack of motivation from instructors.

Table 19: E-learning System Quality Factors

e-learning System Quality Factor	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
I am satisfied with e-learning	29(18%)	10(6%)	32(20%)	50(31%)	40(25%)
E-learning mode is effective	34(21%)	60(37%)	16(10%)	34(21%)	17(11%)
My performance has improved	27(17%)	35(22%)	32(20%)	47(29%)	20(12%)
Cost of e-learning is cheaper	18(11%)	24(15%)	34(21%)	38(24%)	47(29%)

Number of respondents: (N = 180)

g) E-learning System Quality Factors

The results on table 19 shows that 56% of the respondents are satisfied with e-learning, 53% think that e-learning is relatively cheaper than face to face, 49% feel that their performance has improved while 41% think e-learning is an effective mode of teaching.

4.4.2 Instructor and Technicians Results

Table 20: Instructor Characteristics that determine E-learning Quality

Instructor Characteristics	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
We are trained on LMS	4(20%)	7(31%)	3(19%)	3(15%)	3(15%)
We are trained I course development	5(25%)	6(30%)	2(10%)	5(25%)	3(10%)
We are given incentives	7(35%)	8(40%)	-	3(15%)	2(10%)
We attend workshops/seminars	4(20%)	6(30%)	3(15%)	4(20%)	3(15%)

Number of respondents: (N = 20)

h) Instructor Characteristics

The results on table 20 shows that over 50% of are not satisfied with training on LMS and course development. Over 50% were also dissatisfied with provisions for attending workshops or seminars on e-learning as well as incentives at work. One instructor made this comment:

"If the university can include e-learning course development as part of the workload that is considered for payment by the university then we would all be willing to sacrifice out time for it. Otherwise nobody wants to work for free …"

Table 21: Technicians Characteristics that determine E-learning Quality

Technicians Characteristics	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**
We are trained on LMS	6(30%)	6(30%)	1(5%)	4(20%)	3(15%)
We are trained on LMS customization	4(20%)	5(25%)	1(5%)	7(35%)	3(15%)
We are given incentives	5(25%)	6(30%)	2(20%)	5(25%)	2(10%)
We attend workshops/seminars	7(35%)	8(40%)	1(5%)	2(10%)	2(10%)

Number of respondents: (N = 5)

i) Technicians Characteristics

The results on table 21 shows that 55% of the technicians are not satisfied with training on LMS use and LMS customization. Over 5% were also dissatisfied with provisions for attending workshops or seminars on e-learning as well as incentives at work.

Table 22: Institutional Factors that determine E-learning Quality

Institutional Factors	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
	N (%)	N (%)	N (%)	N (%)	N (%)
Funding	5(25%)	6(30%)	1(5%)	5(26%)	3(13%)
Infrastructure	4(20%)	5(25%)	3(15%)	4(20%)	4(20%)
Culture	6(30%)	7(35%)	1(5%)	4(20%)	2(10%)
Policies	5(25%)	5(25%)	-	5(25%)	6(25%)

Number of respondents: (N = 20)

j) Institutional Characteristics

The results on table 22 shows that 55% of the respondent's state that the university lacks funding, infrastructure and polices to manage e-learning. Another 65% adds that the culture of the university does not support e-learning.

4.5 Measurement Model Results

4.5.1 Model Specification

The measurement model specified for the study was used with SPSS-AMOS to test whether the data collected for the study was consistent with the model itself. The model specifies the relationships among measured (observed) variables underlying the latent variables. The current model has seven (7) distinct measurement sub models: Course Design (CD), Content Support (CS), Social Support (SS), Administrative Support (AS), Course Assessment (CA), Institutional Factors (IF) and E-learning System Quality (ESQ).

Consider, for instance, the CD sub model: The scores of the four subtests, CD1, CD2, CD3 and CD4 are hypothesized to depend on the single undisclosed, but not directly observed variable, CD. According to the model, scores on the four subtests may still disagree, owing to the influence of error1, error2, error3 and error4, which represent errors of measurement in the four subtests. CD1, CD2, CD3 and CD4 are called indicators of the latent variable CD. The study also assumes covariance or correlation among the constructs as depicted in the measurement model. Figure 24 illustrates the proposed measurement model.

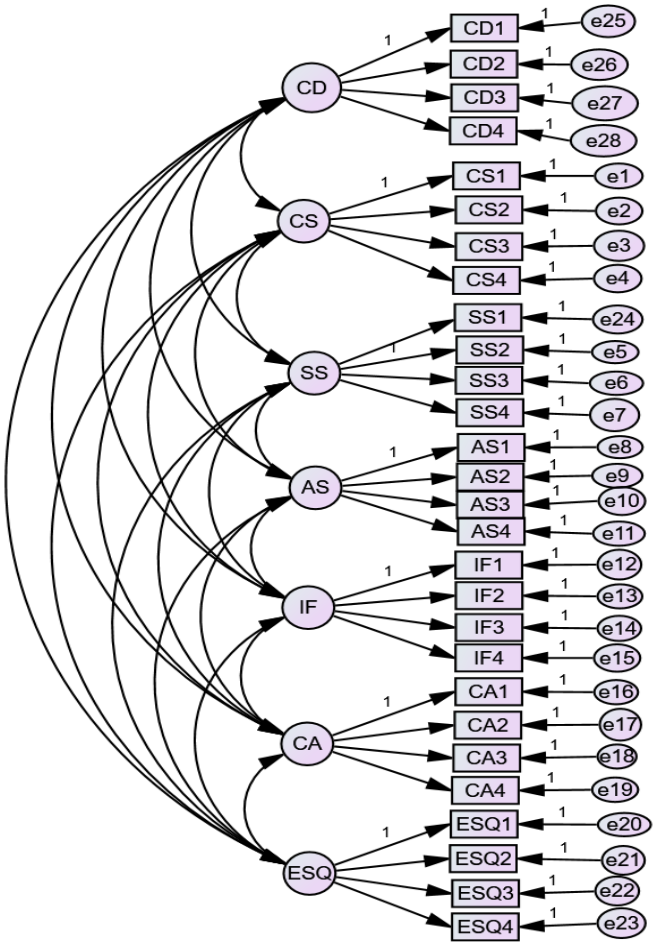

Figure 24: Proposed Measurement Model

4.5.2 Model Identification

The identification of the measurement model was done to determine the DF of the model. The DF was determined by a formula proposed by Rigdon (2009) which states that: DF = Number of sample moments - Number of free parameters in the model. The number of observed variables from the measurement model, k = 28. The full calculations are represented in table 23. The results from the calculations demonstrates that measurement l model is over-identified since DF > 0, implying that it can be validated and estimated for the testing of hypotheses.

Table 23: Measurement Model Degree of Freedom Calculation.

The formula for Number of sample moments = **k (**k+1)/2.	
No of Moments in the distribution	28(29)/2 = 406.
No of variances of the exogenous (predictor) variables	28
No of covariance's of the exogenous (predictor) variables	21
No of errors variances on the exogenous (predictor**) variables**	28
Total Loadings	(21+28) = 49
Number of free parameters in the model	27+21+27+48 = **126**
DF	406-126=**280**.

4.5.3 Model Validation

SEM model was validated using CFA via Validity and Reliability of a latent constructs. The researcher performed CFA for all latent constructs involved in the study before modeling their inter-relationship in a structural model. However, the uni-dimensionality assessment was done prior to assessing validity and reliability. CFA for the measurement model can be conducted separately for each model or pooled at once (all the measurement models). However, the CFA for pooled measurement models is more efficient and highly suggested. Thus, this procedure (Pooled-CFA) for assessing the measurement model of latent constructs was used (Wong, 2013; Hair et al, 2010). The assessment results for each test were as follows:

a) Convergent Validity

A convergent validity test was performed comprising the seven (7) constructs of the study. The FL, AVE and CR values for each construct were determined using SPSS-AMOS and Microsoft Excel. The results obtained were as illustrated in table 24. These results confirm that all the constructs have convergent validity.

Table 24: Measurement Model Validation

No	Construct	Attributes	Cronbach's alpha	AVE	CR	Convergent Validity
1	Course Development	CD1,CD2,CD3 & CD4	0.909	0.728	0.914	ok
2	Course Support	CS1, CS2, CS3 & CS4	0.909	0.728	0.914	ok
3	Social Support	SS1, SS2, SS3 & SS4	0.928	0.815	0.930	ok
4	Admin Support	AS1, AS2, AS3 & AS4	0.881	0.727	0.889	ok
5	Course Assessment	CA1, CA2,CA3 & CA4	0.745	0.789	0.831	ok
6	Institutional Factors	IF1, IF2, IF3 & IF4	0.839	0.729	0.843	ok
7	Learner Characteristics	LC1, LC2, LC3 & LC4	0.770	0.743	0.766	ok
8	Instructor Characteristics	IC1, IC2, IC3 & IC4	0.743	0.801	0.865	ok
9	Technician Characteristics	TC1,TC2,TC3 & TC4	0.725	0.814	0.852	ok
10	E-learning System Quality	ESQ1,ESQ2,ESQ3 & ESQ4	0.870	0.745	0.877	ok

b) Discriminant Validity

A construct's discriminant validity was confirmed for all the constructs as the values of the square root of the AVE exceeded the correlation coefficient between constructs. The results are illustrated in table 25.

Table 25: Discriminant Validity

Constructs	Correlation	Squared. correlation(R^2)	AVE1 (AVEs Should be > R^2)	AVE2	Discriminant Validity
CD<-->CS	0.834	0.696	0.728	0.815	Established
CD<-->SS	0.848	0.719	0.728	0.727	Established
CD<-->AS	0.833	0.694	0.728	0.743	Established
CD<-->CA	0.796	0.634	0.728	0.675	Established
CD<-->IF	0.736	0.541	0.801	0.585	Established
CD<-->ESQ	0.734	0.539	0.728	0.645	Established
CS<-->SS	0.822	0.676	0.815	0.727	Established
CS<-->AS	0. 853	0.727	0.815	0.743	Established
CS<-->CA	0.852	0.726	0.815	0.729	Established
CS<-->IF	0.828	0.686	0.746	0.703	Established
CS<-->ESQ	0.744	0.554	0.815	0.645	Established
SS<-->AS	0.860	0.740	0.757	0.743	Established
SS<-->CA	0.847	0.717	0.727	0.729	Established
CS<-->IF	0.871	0.758	0.744	0.764	Established
SS<-->ESQ	0.794	0.630	0.727	0.645	Established
AS<-->CA	0.785	0.616	0.743	0.729	Established
AS<-->IF	0.705	0.497	0.775	0.781	Established
AS<-->ESQ	0.798	0.637	0.743	0.645	Established
CA<-->IF	0.802	0.643	0.729	0.645	Established
CA<-->ESQ	0.718	0.515	0.764	0.685	Established
IF<-->ESS	0.817	0.667	0.721	0.705	Established

4.5.4 Model Estimation

The maximum likelihood estimation (MLE) is a method of estimating the parameters of a statistical model given observations, by finding the parameter values that maximize the likelihood of making the observations given the parameters. MLE was used with AMOS since it provides a consistent approach to parameter estimation problems. Beyond parameter estimation, the likelihood framework allows us to make tests *o*f parameter values based on the probability values of p values = 0.001 or 0.05. Figure 25 illustrates results of the model estimation.

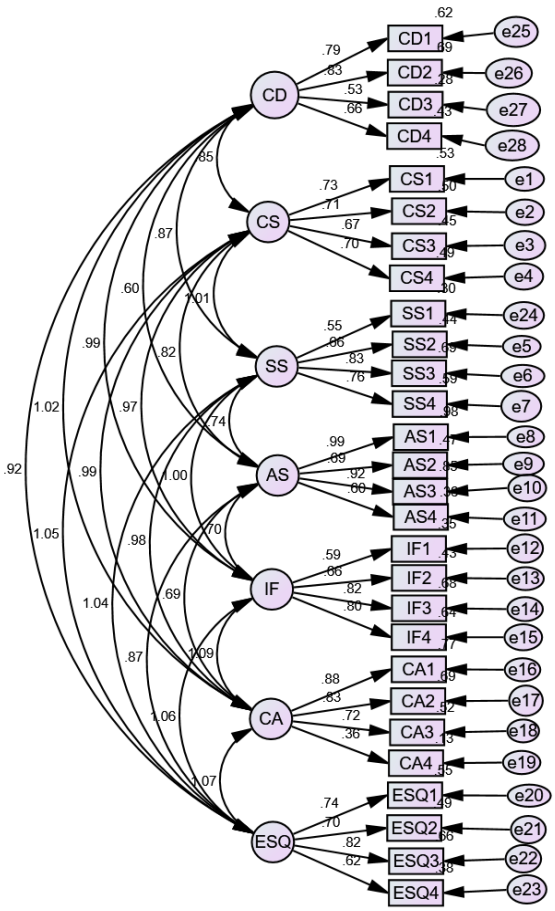

Figure 25: Measurement Model Estimation

4.5.5 Model Evaluation

The results in table 26 shows the standard regression weight estimates or factor loadings and Squared Multiple Correlations. Since the factor loading values lie between 0.529 and 0.988, all the indicators have surpassed the minimum threshold value of 0.4 (Fornell & Larcker, 1981; Hair et al., 2010). It can also be concluded that all the indicators measure their respective constructs in a reliable manner.

Table 26: Standardized Regression Weights for Measurement Model

Construct	Indicator	Standard Estimate	Squared Multiple Correlations
Course Development	CD1	0.790	.487
	CD2	0.831	.627
	CD3	0.529	.304
	CD4	0.66	.420
Content Support	CS1	0.725	.538
	CS2	0.706	.502
	CS3	0.672	.463
	CS4	0.701	.453
Social Support	SS1	.551	.300
	SS2	0.66	.446
	SS3	0.833	.679
	SS4	0.765	.595
Admin Support	AS1	0.988	.977
	AS2	0.7071	.500
	AS3	0.922	.849
	AS4	0.606	.367
Institutional Factor	IF1	0.592	.349
	IF2	0.657	.435
	IF3	0.824	.674
	IF4	0.799	.648
Course Assessment	CA1	0.876	.730
	CA2	0.833	.732
	CA3	0.723	.580
E-learning System Quality	ESQ1	0.742	.510
	ESQ2	0.702	.480
	ESQ3	0.815	.723
	ESQ4	0.618	.434

4.5.6 Model Fit

SEM fit indices obtained after running the model established whether; overall, the model was acceptable. An acceptable model allows the researcher to establish whether specific paths are significant while acceptable fit indices imply strong relationships among variables. Studies by Hair et al. (2010) and Bentler (1990) recommended the use of at least four fit indices: GFI, CFI, NFI and RMSEA, to evaluate a model fit. The model fit indices were obtained during MLE estimation in section 4.5.4. These values presented in table 27. Two fit indices were accepted without achieving an overall acceptable fit measures for the following reasons. MacCallum et al. (1996) argued that RMSEA in the range of 0.05 to 0.10 was considered an indication of fair fit and values above 0.10

indicated poor fit so the value of 0.085 was accepted. Miles and Shevlin (1998) observed that the cut-off point for GFI should be 0.90 for high sample sizes and 0.95 for low sample size. Since the study used a high sample size (180), it regards 0.90 an acceptable fit. The other two fit indices were achieved with normal thresholds. The overall results suggest that the measurement model is acceptable.

Table 27: Fit Indices for Measurement Model

No	Fit Index	Expected N =180	Result	Remarks
Chi-Square = 360.372		Degree of freedom = 406		
Absolute Fit Measures				
1	Goodness of Fit (GFI)	> 0.95	0.920	Slightly lower but acceptable
2	Root Mean Squared Error of Approximation (RMSEA)	< 0.08	0.085	Slightly above threshold but acceptable
3	Comparative Fit Index (CFI)	> 0.95	0.981	Passed
4	Normed Fit Index (NFI)	> 0.95	0.977	Passed

4.5.7 Model Modification

Modification indices offer suggested remedies to discrepancies between the proposed and estimated model. In the study, the modification could not be done by way of adding regression lines to fix model fit, as all regression lines between latent and observed variables were already in place. The modification therefore involved co varying error terms that were not part of the same factor as well as addressing the largest modification indices before addressing more minor ones. It was noticed that there were high covariance values between the factors, which indicated a violation against construct validity (discriminant validity) that is some variables were inter-correlated. This problem was solved by co varying the error terms modification indices as shown in table 28. Figure 26 illustrates the modified Measurement Model with modification indices and error co-variances while figure 26 shows the Measurement Model after modification.

Table 28: Measurement Model error Modification Indices

			M.I	Par Change
e17	<-->	e20	44.243	0.058
e16	<-->	e25	22.823	0.051
e15	<-->	e26	22.759	-0.061
e14	<-->	e18	18.205	-0.045
e14	<-->	e21	31.851	0.084
e9	<-->	e22	26.917	-0.054
e4	<-->	e18	38.802	0.068

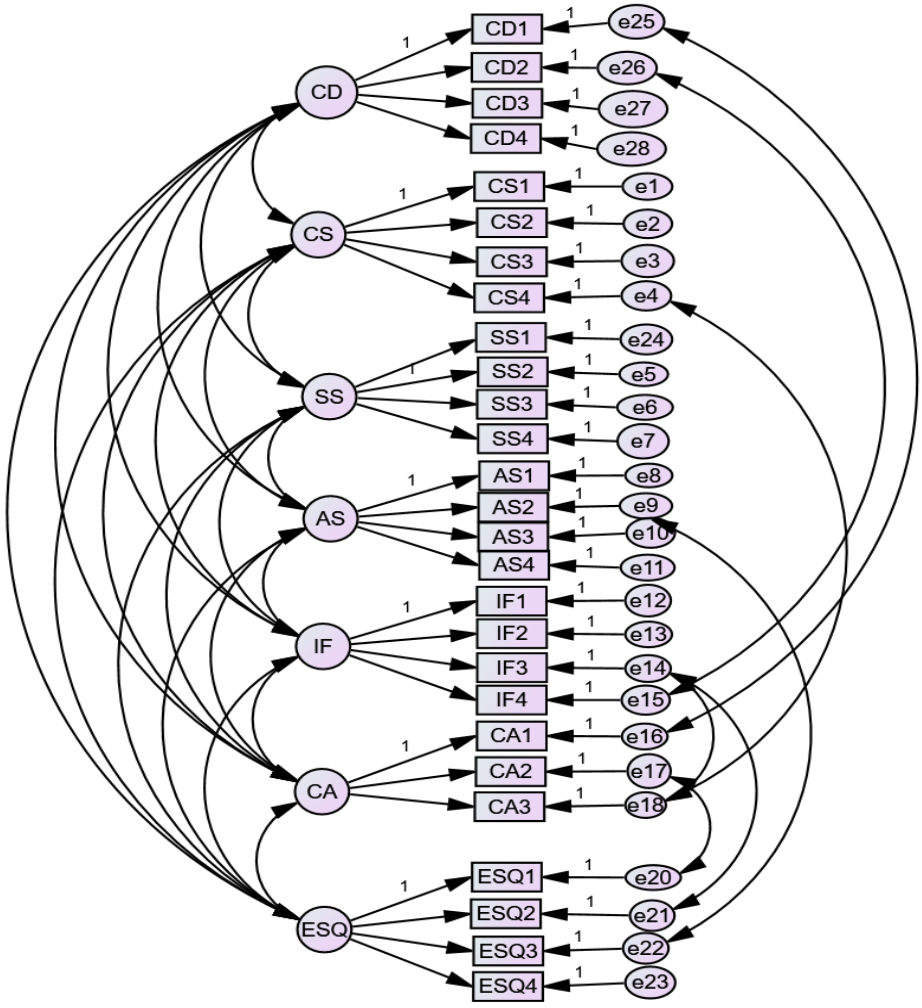

Figure 26: Measurement Model with Modification indices

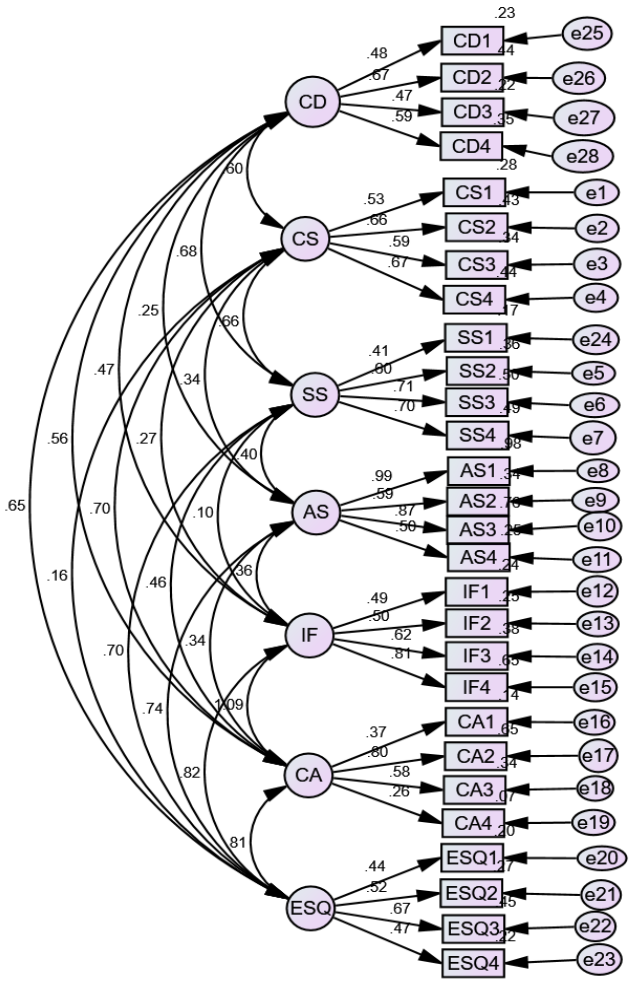

Figure 27: Measurement Model after modification

4.6 Structural Model

Once the measurement model was tested and confirmed to have a good model fit, the next step involved constructing a structural model (path diagram) to test the research hypotheses. Structural models consist of rectangles for observed variables, ellipses for latent variables, curves with arrow-heads on both sides for correlations and most important: straight lines with arrow-heads on one end as paths that link a predicting and a predicted variable. The path diagram in figure 28 represents the study's structural model consisting of the causal relationships among the identified latent and observed variables (indicators) with error terms for each endogenous and observed variable. Structural model focuses on the strengths of the causal relations between the constructs as established from theory unlike the measurement model that focuses on testing how well the indicator variables measure the constructs.

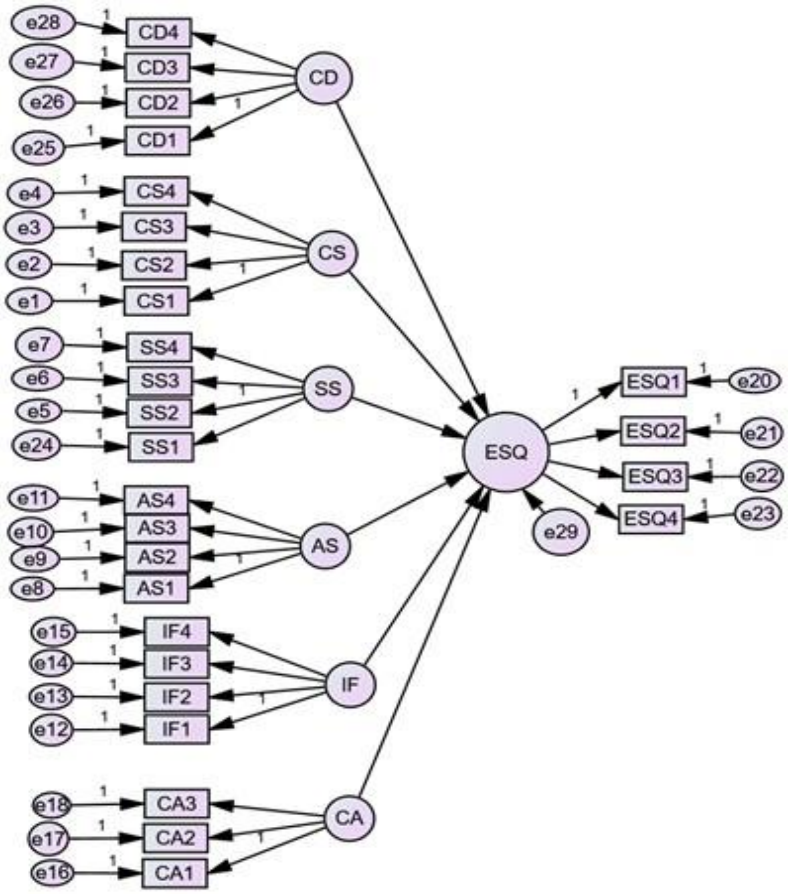

Figure 28: Proposed Path Diagram/Structural Model

4.6.1 Model Identification

The identification of the structural model was done to determine the DF of the model and compare it with that of the measurement model. The DF was determined by applying similar formula used for calculating for measurement model. The results are presented in table 29.

Table 29: Structural Model Degree of Freedom Calculation

The formula for Number of sample moments = **k (**k+1)/2.	
No of Moments in the distribution	27(28)/2 = 387
No of variances of the exogenous (predictor) variables	27
No of errors variances on the exogenous (predictor**) variables**	27
No of error variance on the endogenous variable	1
No of Latent variable	6
Total Loadings	(23+6+4) = 33
Number of free parameters in the model	27+27+8+36 = **98**
DF	378-99=**280**.

The results from the calculations above shows that structural model is over-identified since DF > 0, implying that it can be validated and estimated for the testing of hypotheses. The results in table 30 compares the DFs for both models and proves that both models attained the same DF. However, the structural model has slightly fewer parameters than the measurement model.

Table 30: Structural Model DF vs Measurement Model DF

	Measurement Model	Structural model
Number of distinct sample moments:	406	378
Number of distinct parameters to be estimated:	126	98
Degrees of freedom (378-95):	280	280

4.6.2 Model Estimation

In the SEM structural model, any endogenous latent variable must have an error term. Secondly, the exogenous variables must also have correlations amongst them. The structural model estimation was done using MLE technique as previously done for the measurement model using the same indices thresholds. Figure 29 depicts the results of the structural model estimation while table 31 presents the Standardized Regression Weights for both Measurement & Structural models.

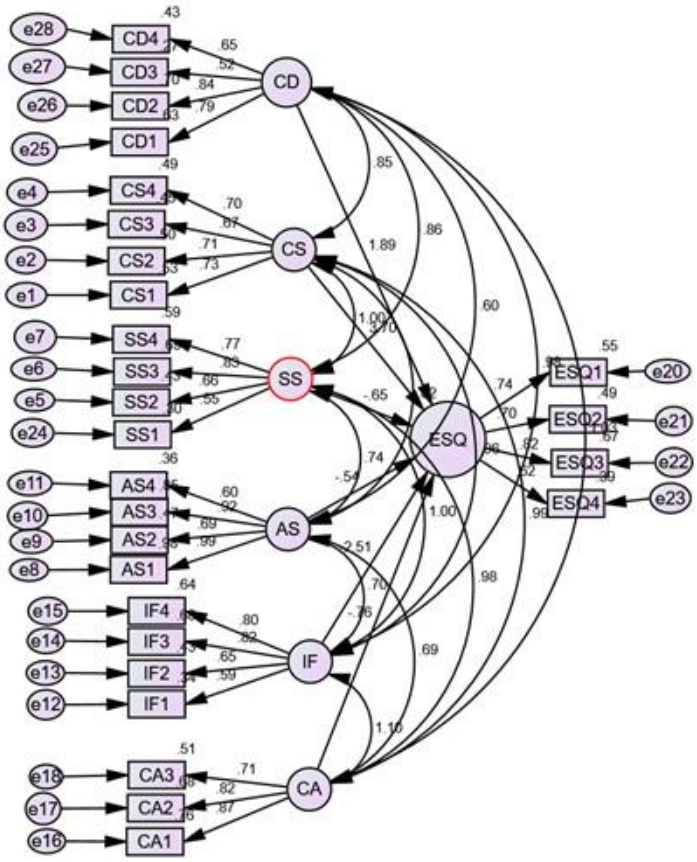

Figure 29: Standardized Estimates for Structural Model

In the structural model, the factor loadings obtained are the same as those previously obtained for measurement model. This means that all the indicators measure their respective constructs reliably. The comparisons of the two estimates are presented in table 32.

Table 31: Standardized Regression Weights for Both Measurement & Structural Model

Construct	Indicator	Measurement Model Estimate	Structural Model Estimate	Squared Multiple Correlations
Course Development	CD1	0.790	0.790	.487
	CD2	0.831	0.831	.627
	CD3	0.529	0.529	.304
	CD4	0.660	0.660	.420
Content Support	CS1	0.725	0.725	.538
	CS2	0.706	0.706	.502
	CS3	0.672	0.672	.463
	CS4	0.701	0.701	.453
Social Support	SS1	.551	.551	.300
	SS2	0.66	0.66	.446
	SS3	0.833	0.833	.679
	SS4	0.765	0.765	.595
Administrative Support	AS1	0.988	0.988	.977
	AS2	0.7071	0.7071	.500
	AS3	0.922	0.922	.849
	AS4	0.606	0.606	.367
Institutional Factor	IF1	0.592	0.592	.349
	IF2	0.657	0.657	.435
	IF3	0.824	0.824	.674
	IF4	0.799	0.799	.648
Course Assessment	CA1	0.876	0.876	.730
	CA2	0.833	0.833	.732
	CA3	0.723	0.723	.580
E-learning System Quality	ESQ1	0.742	0.742	.510
	ESQ2	0.702	0.702	.480
	ESQ3	0.815	0.815	.723
	ESQ4	0.618	0.618	.434

4.6.3 Model Fit

The model fit for the structural model was conducted using the same fit indices used previously with the measurement model. The result presented in table 32 compares the two outcomes and indicate that the structural and measurement models achieve overall acceptable fit measures for the various proposed fit indices, therefore, suggesting that the structural model is also acceptable (Hair et al,2010; Bentler, 1990).

Table 32: Fit Indices for Structural and Measurement Model

No	Fit Index	Expected N =180	Measurement Model	Structural Model	Remarks
	Chi-Square = 460.		DF = 406		DF = 378
	Absolute Fit Measures				
1	Goodness of Fit (GFI)	> 0.95	0.920	0.916	Slightly lower but acceptable
2	Root Mean Squared Error of Approximation (RMSEA)	< 0.08	0.085	0.073	Slightly above threshold but acceptable
3	Comparative Fit Index (CFI)	> 0.95	0.981	0.956	Passed
4	Normed Fit Index (NFI)	> 0.95	0.977	0.942	Passed

4.7 Hypothesis Testing

The next section studies the structural model estimates and compare the results with the hypotheses made in the proposed conceptual model. The following hypotheses were to be tested from the conceptual model.

4.7.1 Direct Hypotheses Results

There were six direct hypotheses:

- H_1: Course Design factors significantly affect e-learning system quality.
- H_2: Content Support significantly affects e-learning system quality.
- H_3: Social Support significantly affects e-learning system quality.
- H_4: administrative support significantly affects e-learning system quality.
- H_5: Course Assessment *significantly* affects e-learning quality.
- H_6: e-learning institutional factors significantly affect e-learning quality.

The construct hypotheses test results in table 33 indicate that out of the six main hypotheses, five were supported while one was rejected. The tests were based on significant level of 0.05 and one-tailed tests.

Table 33: Construct Hypothesis Test Results

Hypothesis	Path			Estimate	CR	P	Hypothesis Test
H1	CD	<----	ESQ	.458	4.562	0.048	Yes
H2	CS	<----	ESQ	.542	5.334	0.045	yes
H3	SS	<----	ESQ	.623	4.732	0.051	Yes
H4	AS	<----	ESQ	.401	3.231	0.035	yes
H5	IF	<----	ESQ	.732	4.343	0.043	yes
H6	CA	<----	ESQ	.105	0.831	0.137	no

4.7.2 Indirect Hypotheses Results

There were 23 indirect hypotheses out of which all were supported according to the results presented in table 34. When the model was estimated in AMOS, a p value of 0.041 was obtained for all the factors using one tailed measurement. Given that, the value of p is < 0.05, all the values are considered significant, and all the hypotheses were passed. The results are summarized in table 34.

Table 34: Indirect Hypothesis Test Results

SN	Path	Factor Loading	Hypothesis Test
1	CD1 <---- CD	0.790	passed
2	CD2 <---- CD	0.831	passed
3	CD3 <---- CD	0.529	passed
4	CD4 <---- CD	0.660	passed
5	CS1 <---- CS	0.725	passed
6	CS2 <---- CS	0.706	passed
7	CS3 <---- CS	0.672	passed
8	CS4 <---- CS	0.701	passed
9	SS1 <---- SS	.551	passed
10	SS2 <---- SS	0.66	passed
11	SS3 <---- SS	0.833	passed
12	SS4 <---- SS	0.765	passed
13	AS1 <----AS	0.988	passed
14	AS2 <----AS	0.707	passed
15	AS3 <----AS	0.922	passed
16	AS4 <----AS	0.606	passed
17	CA1 <----CA	0.876	passed
18	CA2 <----CA	0.833	passed
19	CA3 <----CA	0.723	passed
20	IF1 <----IF	0.592	passed
21	IF2 <----IF	0.657	passed
22	IF3 <----IF	0.824	passed
23	IF4 <----IF	0.799	Passed

From the table, it can be concluded that:

$H_{1.1}$: Course information significantly affects course development (CD1).
$H_{1.2}$: Content structure significantly affects course development (CD2).
$H_{1.3}$: Course Layout significantly affects course development (CD3).
$H_{1\,4}$: Course Organization significantly affects course development (CD4).

$H_{2.1}$: Announcements & reminders significantly affect content support (CS1).
$H_{2.2}$: Use of multimedia significantly affects content support (CS2).
$H_{2.3}$: Constructive feedback significantly affects content support (CS3).
$H_{2.4}$: An authentic learning activity significantly affects content support (CS4).

$H_{3.1}$: Informational Support significantly affects social support (SS1).
$H_{3.2}$: Instrumental Support significantly affects content support (SS2)
$H_{3.3}$: Affirmation support significantly affects content support (SS3).
$H_{3.4}$: Emotional Support significantly affects content support (SS4).

$H_{4.1}$: Campus Orientation significantly affects admin support (AS1).
$H_{4.2}$: Course Registration support significantly affects admin support (AS2).
$H_{4.3}$: Academic Advice significantly affects admin support (AS3).
$H_{4.4}$: Departmental Call Center significantly affects admin support (AS4).

$H_{5.1}$: Lost Grades significantly affect Assessment Quality (CA1).
$H_{5.2}$: Better assignment management significantly affects Assessment Quality (CA2).
$H_{5.3}$: Assessment feedback significantly affects Assessment Quality (CA3).
$H_{5.4}$: Course Content significantly affects Assessment Quality CA4).

$H_{6.1}$: Funding significantly affect e-learning quality (IF1).
$H_{6.2}$: Infrastructure factors significantly affect e-learning quality (IF2).
$H_{6.3}$: Policy factor significantly affects e-learning quality (IF3).
$H_{6.4}$: E-learning culture significantly affects e-learning quality (IF4).

4.8 Moderation Analysis

The moderation model was created by first creating three coefficients or z-scores for each of the three moderating factors: learner characteristics (LC), instructor characteristics(IC) and technician characteristics (TC). A fourth coefficient known as moderator coefficient was created by getting the average of the three z-scores. By using linear regression analysis, the outcome variable was added as the dependent variable while the three z-scores plus the moderator coefficient was added as the indecent variables. The model was estimated and the resulting outputs were noted and observed for significance for each of the six (6) hypotheses listed below:

H_7: The effect of course design on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_8: The effect of content support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_9: The effect of social support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{10}: The effect of administrative support on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{11}: The effect of course assessment on e-learning system quality is moderated by learner, instructor and technician characteristics.

H_{12}: The effect of institutional factors on e-learning system quality is moderated by learner, instructor and technician characteristics.

4.8.1 Hypothesis 7

Table 35: Moderation of Course Design

Z-score values	Standardized Beta Coefficients	Sig.	Adjusted R Square
TC z-core	0.345	.046	0.724
LC z-score	0.116	.0613	
IC z-score	0.765	.000	
Moderator variable	0.809	.000	

a. Dependent Variable: Course Design

From table 35, it is evident that the moderator variable is significant with the model summary predicting 72% of variance, which is a sign that the data fits the model. It is also important to note that LC variable drops out (0.078>0.05). Meanwhile both IC and TC are significant and therefore both moderate CD with IC having the highest coefficient (0.765).

4.8.2 Hypothesis 8

Table 36: Moderation of Content support

Z-score values	Standardized Beta Coefficients	sig	Adjusted R Square
TC z-core	0.351	.032	0.621
LC z-score	-0.125	.082	
IC z-score	0.562	.024	
Moderator variable	0.825	.000	

b. Dependent Variable: content support

Results from table 36 indicate that the moderator variable is significant with the model having 62% of variance. However, LC variable and do not moderate content support. It is only the IC variable and the TC variable that are significant and therefore do moderate content support.

4.8.3 Hypothesis 9

Table 37: Moderation of Social Support

Z-score values	Standardized Beta Coefficients	sig	Adjusted R Square
TC z-core	0.103	0.125	0.761
LC z-score	0.538	.037	
IC z-score	0.440	.047	
Moderator variable	0.652	.000	

b. Dependent Variable: social support

The result from table 37 show that the moderator variable is significant and the model attains a variance of 76% proving that the data supports the model. Both LC and IC are significant and therefore both moderate Social Support. TC is not significant and therefore does not moderate Social Support.

4.8.4 Hypothesis 10

Table 38: Moderation of Administration Support

Z-score values	Standardized Beta Coefficients	sig	Adjusted R Square
TC z-core	0.403	0.031	0.518
LC z-score	0.538	.274	
IC z-score	0.347	.044	
Moderator variable	0.527	.000	

b. Dependent Variable: Admin Support

The result from table 38 show that the moderator variable is significant and the model attains a variance of 52% proving that the data supports the model. Both IC and TC are significant and therefore moderate AS. LC is not significant and therefore does not moderate SS.

4.8.5 Hypothesis 11

Table 39: Moderation of Course Assessment

Z-score values	Standardized Beta Coefficients	sig	Adjusted R Square
TC z-core	0.114	0.512	0.583
LC z-score	0.109	.206	
IC z-score	0.674	.050	
Moderator variable	0.581	.000	

b. Dependent Variable: Course Assessment

The results of table 39 show that the moderator variable is significant and model has a variance of 58% proving that the data fits the model. However, it is only the IC variable that proves to be significant while both LC and TC are not. This suggests that it is only the IC variable that moderates CA.

4.8.6 Hypothesis 12

Table 40: Moderation of Institutional Factors

Z-score values	Standardized Beta Coefficients	sig	Adjusted R Square
TC z-core	0.303	0.031	0.518
LC z-score	0.538	.274	
IC z-score	0.347	.042	
Moderator variable	0.527	.000	

b. Dependent Variable: Institutional Factors

The result from table 40 show that the moderator variable is significant and the model attains a variance of 52% proving that the data supports the model. Both IC and TC are significant and therefore moderate IF. LC is not significant and therefore does not moderate SS.

4.8.7 Moderator Analysis Results

The detailed analysis of the moderator factors shows that out of 18 hypotheses, only 10 were supported while six (6) were rejected. The findings are presented in table 41.

Table 41: Moderator Analysis Results

Relation	Beta Coefficient	significance	Hypothesis Test
TC->CD	0.345	0.046	passed
LC->CD	0.116	0.078	failed
IC->CD	0.765	0.000	passed
TC->CS	0.114	0.512	failed
LC->CS	0.109	0.206	failed
IC->CS	0.674	0.050	passed
TC->SS	0.103	0.125	failed
LC->SS	0.538	0.037	passed
IC->SS	0.347	0.047	passed
TC->AS	0.114	0.037	passed
LC->AS	0.538	0.274	failed
IC->AS	0.347	0.04	passed
TC->CA	0.114	0.512	failed
LC->CA	0.538	0.274	failed
IC->CA	0.440	0.047	passed
TC->IF	0.303	0.031	passed
LC->IF	0.538	0.274	failed
IC->IF	0.347	0.042	passed

4.9 Discussion of Findings

4.9.1 Quality Status Results Discussions

The findings from the study show that course design has quality in terms of layout and course information. This conforms to Wright (2014) guidelines for quality. However, improvement is needed in the organization and structure in conformance with the guidelines provided by Wright (2014). Although the findings showed that content was well supported with course announcements and reminders, there is inadequate use of multimedia and poor feedback from instructors. Lim, Kang & Park (2016) postulates that rich and relevant content should always be incorporated in e-learning courses to boost quality so this another area of improvement.

Another area that JKUAT needs to work on is on social support. The study asserted that their social support through forum or chat were nonexistent. The support which can be created from sources such as such as, peer groups, forum, chat and e-learning group work (Weng and Chung, 2015; Queiros & Villiers, 2016) is instrumental in helping isolated learners receive help from peers.

However, JKUAT was reported to be doing well in providing administrative support in the form of on-campus orientation, course registration and academic advice all this coming when the students initially report to the University. The same goes for assessments, which are well managed, except for a few cased of missing grades and delayed examination results. This conforms to finding by Chawinga (2016), who observed that universities should safeguard student's grades and release end of semester examinations on time to avoid inconveniencing the learners.

However, the biggest problem facing JKUAT e-learning system is lack of funding necessary for implementing quality system. Findings show that the learning infrastructure is inadequate due to lack of funds. This area needs improvement to conform a study by Tarus, Gichoya & Muumbo (2015), which recommendations that observed that these technological components play a critical role in facilitating quality e-learning. JKUAT needs to look for funds, create policies and improve infrastructure as advocated for by Kashorda & Waema (2014).

With the availability of funds, adequate training and motivation can be provided for both the Instructors and the technicians (Arinto, 2016; Azawei et al., 2016). The improvement of JKUAT system will improve user satisfaction, performance, enrolment. This assumption is in line with the findings by Raspopovic et.al (2014), who was categorical that quality e-learning system improves user satisfaction, information quality, service quality, academic achievement and performance. The next section discusses the effects of the quality status results in the study.

The quality status of JKUAT in terms of the rate at which each quality factor met the four prescribed indicators per factor is summarized in table 42. The quality status was rated at 57.5% in terms of how much quality is available at JKUAT. With an above average rating, the results indicates that the choice of JKUAT as a case study to validate the research model was satisfactory. However, the study also directed that a lot improvement is needed to in order meet most of the recommend quality factors of an e-learning system.

Table 42: Summary of Quality Status of JKUAT.

	Factor	Indicator 1		Indicator 2		Indicator 3		Indicator 4		Fraction	% Quality Status
1	**Course Design**	CD1	Yes	CD2	No	CD3	Yes	CD4	No	2/4	50
2	**Content Support**	CS1	Yes	CS2	Yes	CS3	No	CS4	No	2/4	50
3	**Social Support**	SS1	Yes	SS2	Yes	SS3	No	SS4	No	2/4	50
4	**Admin Support**	AS1	Yes	AS2	Yes	AD3	Yes	AD4	No	3/4	75
5	**Course Assessment**	CA1	Yes	CA2	Yes	CA3	Yes	CA4	Yes	4/4	100
6	**Learner Characteristics**	LC1	Yes	LC2	Yes	LC3	No	LC4	Yes	3/4	75
7	**Instructor Characteristics**	IC1	No	IC2	Yes	IC3	No	IC4	No	2/4	50
8	**Technician Characteristics**	TC1	No	TC2	No	TC3	Yes	TC4	Yes	2/4	50
9	**E-learning System Factors**	ESQ1	Yes	ESQ2	No	ESQ3	Yes	ESQ4	No	2/4	50
10	**Institutional Factors**	IF1	No	IF2	No	IF3	Yes	IF4	No	1/4	25

Average Quality Status: 575/100 = **57.5%**

4.9.2 Quality Status Results and its Effects

The first part of the study set out to identify the e-learning system evaluation factors that determine the quality of e-learning in HEIs and use the factors to determine the status of e-learning system quality at JKUAT using empirical data. From the literature review, it was established that there are indeed nine (9) factors that determine quality: course design, content support, social support, administrative support, course assessment, learner characteristics, instructor characteristics and technician characteristics.

In the questionnaire, the respondents were asked two questions regarding each indicator with the first question asking whether the quality indicator was provided for by the e-learning system

while question two inquired whether the said indicator improved the quality of the e-learning system. From the responses, the researcher was able to independently establish the quality status using frequencies as well as the hypotheses using factor loadings. Consequently, the status results showed that the JKUAT system lacked some factors necessary for quality e-learning(section 4.4, tables 13-22) while factor loadings findings for most of the indicators and beta coefficients for moderators(sections 4.7.2 & 4.8.7, tables 34 & 41 respectively)were high showing that the status results did not affect the hypothesis results.

4.9.3 Derivation of an E-learning Evaluation Model

The second part of the study set out to develop a model of evaluating e-learning system quality. This is represented in figure 28 in section 4.6, which illustrates the structural model diagram summarizing the relationships between the latent and observed variables as defined in the proposed conceptual model. The study's main task was to test a number of hypotheses between the dependent variables and the predictor variables.

The results of the tests show that there is a strong correlation between content support(CS) and e-learning system quality(ESQ) with an FL of 0.542, between social support(SS) and e-learning system quality(ESQ) having FL of 0.623 and between infrastructure (IF) and e-learning system quality(ESQ) with an FL of 0.532.

The strong correlation between CS and ESQ is attributable to that fact that the use of multimedia and the provision of frequent feedback in an e-learning environment is critical in determining the success of learning. The strong correlation between SS and ESQ is attributable to that fact that since the learners are always out on their own, social support through peer, family and instructors via media such as forum and chat are the only means of interactions that can be applied.

The strong correlation between IF and ESQ is attributable to that fact that the both content support and social support can only work well if a good e-learning infrastructure, policies and funding are in place. Further results of analysis show that most of the hypothesized relationships in the model were tested and proven to hold with a few exceptions. The subsequent findings from the study are summarized in section (a-f) below:

a) H_1-Hypothesis 1

The first alternative hypothesis of the study proposed that there is significant relationship between course design and e-learning system quality. This hypothesis was supported with a moderate factor loading value. The relationship between the two variables is due to the fact that an e-learning course design is influenced by factors such as information about the course, structure, layout and the general way that the courses is organized.

This finding is consistent with QMRS (2014) and Wright (2014) rubrics and guidelines which stated that some of the most critical aspects of an e-learning course design include but are not limited to course information, course layout, course structure and course organization.

b) H_2-Hypothesis 2

The second alternative hypothesis of the study proposed that there is significant relationship between the content support and e-learning system quality. This hypothesis was supported with a high factor loading value owing to the fact that quality of as viewed by the learners was influenced by the use of video tutorials and the challenges experienced regarding lack of feedback from instructors as well as the purported lack of content "authenticity" or content without real life application. Consequently, the perceived content support had a strong correlation effect on the quality of the e-learning system.

In a similar study to create a model for assessing LMS success in higher education in sub-Saharan countries, Mtebe and Raisamo (2014a) developed an evaluation model, which included content support as one of the constructs to measure LMS success. Similarly, Makokha & Mutisya (2016) conducted a study on the challenges affecting adoption and use of e-learning in public universities in Kenya that established that that most of the course modules were not interactive as lecturers used their LMS as a document repository where materials such as PowerPoint presentations, lecture notes, and essential readings are uploaded.

c) H_3 – Hypothesis 3

The third alternative hypothesis of the study proposed that there is a significant relationship between the perceived social support and the e-learning system quality. This hypothesis was

supported with the highest factor loading owing to the fact that the quality as viewed by learners had been hampered by lack of social support through lack of group chat, group work and forum which are meant to facilitate learning.

In a similar study to determine the right connections for online students in a South African Higher Education Institution (Queiros and de Villiers,2016), it was empirically proved that: Strong social presence through interaction with facilitators, peer-to-peer contact, discussion forums and collaborative activities can help improve quality of e-learning systems. This is consistent with the findings of the study. The availability of social support was further highlighted by Makokha & Mutisya (2016) who proved that the Interactivity of an e-learning course could be enhanced by the inclusion of different learner activities such as discussion forums, group discussions, and hidden questions within each weekly lesson notes and self-assessment tests.

Similarly, Muuro et al. (2014) in a study on online collaborative learning and intelligent grouping using LMS observed that online group work as a learning tool from should be included in instructional design as it helps students to understand the course better.

d) H_4 – Hypothesis 4

The fourth alternative hypothesis of the study proposed that there is a significant relationship between the perceived administrative support and the quality of an e-learning system. This hypothesis was supported though with a marginal value of factor loading. There is a positive relationship between the two variables because the students to be crucial in determining quality viewed administrative support such as campus orientation, course registration, academic guidance and the provision of a call center for the students.

This finding is consistent with the outcome of the pre-study conducted earlier on to get insights about variables that might affect e-learning system quality.

e) H_5-Hypothesis 5

The fifth alternative hypothesis proposed that there is significant relationship between the course assessment and e-learning system quality. This hypothesis was rejected. The rejection

could be attributed to the fact that the issues that were raised by the students regarding assessments such as delay in approving and releasing results, loss of grades, too many assignments and doing both CATs and examinations at the end of the semester seemed not to negatively affect the majority of the learners. Furthermore, some students were of the opinion that these factors were irrelevant as long as they were passing the assessments.

This finding is in contradiction with the findings by Chawinga (2016) who in an empirical study on increasing access to higher education through Open and Distance Learning in Malawi observed that delayed feedback of assignments and release of end of semester examination results were affecting the quality of learning.

f) H_6-Hypothesis 6

The sixth alternative hypothesis of the study proposed that there is significant relationship between the institutional factors and e-learning system quality. This hypothesis was supported with a high factor loading value owing to the fact that quality as viewed by the instructors and technicians highly depended on funding, infrastructure, policy and the culture of an institution. Funds are needed to support and maintain the infrastructure and the staff; policies facilitate the smooth running of the system; a culture of e-learning use and support is vital.

In a related study on the challenges of Implementing e-Learning in Kenyan public universities, Tarus, Gichoya & Muumbo (2015) observed that inadequate ICT and e-learning infrastructure, Financial constraints, Lack of affordable and adequate Internet bandwidth, Lack of operational e-learning policies and Lack of interest and commitment among the teaching staff to use e-learning were the main stumbling blocks in preventing quality e-learning. This is in line with findings of the study.

Similarly, a study by Azawei et al. (2016) on the barriers and opportunities of e-learning implementation in Iraqi public universities observed that low internet bandwidth, insufficient financial support, inadequate training programs, lack of technical support, lack of ICT infrastructure and ambiguous plan and policies were the major stumbling blocks hindering the implementation of quality systems. This is also in conformance with the finding of the study.

4.9.4 Moderator Analysis Discussion

Basing our arguments on results obtained from section 4.8.7, there exists some relationships between the quality variables and the Learner characteristics, instructor characteristics and technician characteristics. The finding show that eleven (11) out the eighteen (18) moderator variable hypotheses hold. The two scenarios that have emerged are that (1), the effect of course development, content support, academic support and infrastructure on e-learning system is moderated by instructor characteristics and technician characteristics and (2), the effect of social support on e-learning system is moderated by instructor characteristics and learner characteristics.

The first scenario can be justified because both the instructors and the technicians are directly involved with e-learning system (instructor in course development and technician in preparing the infrastructure).This is also in line with the findings from the pre-study which postulated that technicians are involved in several e-learning system activities such as installing and customizing the LMS, creating user accounts, uploading content, troubleshooting the network system and generally ensuring a smooth running of the e-learning platform.

4.9.5 Validated Model

The chapter ends with the creation of a validated and evaluated e-learning system quality model. The model was validated because of using the structural model to test the six hypothesized path diagram relationships between the observed and the latent variables. Five out six hypotheses were supported except for the relationship between course assessment and e-learning system quality, which proved to be insignificant. This relationship was dropped from the model.
The moderating effects of the various identified variables were also tested and reported with ten (10) out of eighteen (18) being supported. The ten supported relationships were: TC->CD, IC->CD, IC->CS, LC->SS, IC->SS, IC->AS, TC->AS, IC->CA, TC->IF and IC->IF. The validated model was therefore derived from only those factors that passed the hypothesis tests. This model is represented in figure 30.

In the model, the evaluation process of an e-learning system can be divided into five major phases :(1) course design, (2) content support, (3) social support, (4) administrative Support, and (5)

institutional factors. Social support is moderated by learner characteristics. Instructor characteristics moderate all the five factors while technician factors moderate course design, content support, administrative Support, and institutional factors.

1. **Course Design Evaluation** consists of course information, content structure, content layout and content organization.
2. **Content Support Evaluation** consists of announcements and reminders use of multimedia, constructive feedback and authentic learning activities.
3. **Social Support Evaluation** consists of: student-to-student communications, use of group work, chat and forum.
4. **Administrative Support Evaluation** consists of orientation, academic advice, registration support and call center.
5. **Institutional factors Evaluation** consists of infrastructure, culture, polices and funding.

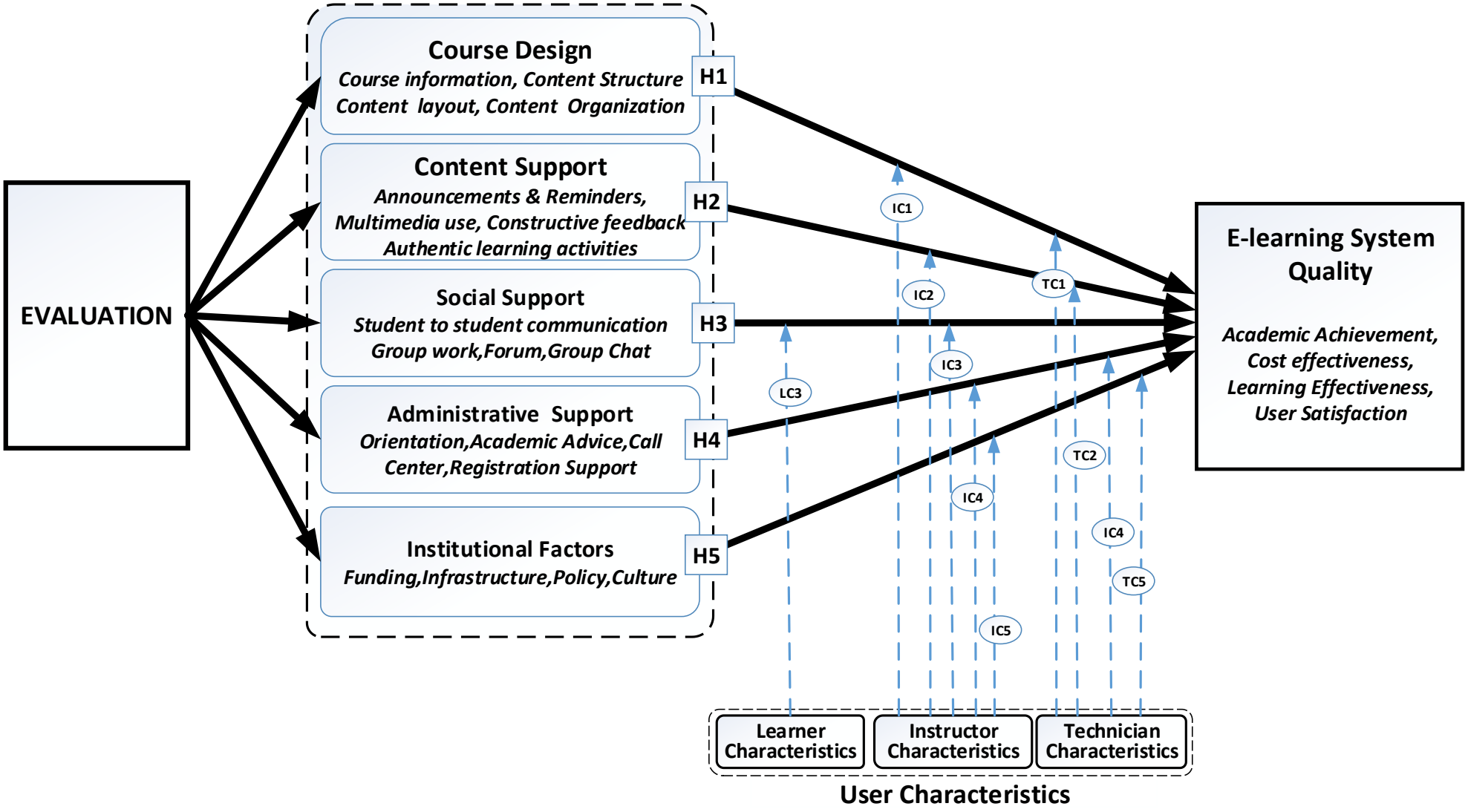

Figure 30: Validated E-learning Evaluation Model

4.9.6 Benchmarking Model with Quality Rubrics

Edith Cowan University (ECU) defines benchmarking as a continuous and systematic process of comparing products, services, processes and outcomes with other organizations or exemplars, for improving outcomes by identifying, adapting and implementing best practice approaches (Edith Cowan University, 2011). Several different benchmarks or quality standards have been defined and tested in numerous contexts around the world regarding what constitutes quality in online learning (Frydenberg, ,2002; Jung, 2010; Ehlers, 2004; Jara & Mellar, 2007; Commonwealth of Learning ,2009).

The benchmarks have developed Ten (10) standards or Rubrics for Quality online learning. The Rubrics present a set of evaluative dimensions for each standard. The ten areas constituting quality in online learning within higher education are: Course Design; Resources for Quality evaluation; Web Usability; Online Assessment; Course Technology; Learner Support; Administrative Support; Institutional Structures; System Review and Structure of the Virtual Environment(Frydenberg, ,2002; Jung, 2010; Ehlers, 2004; Jara & Mellar, 2007; Commonwealth of Learning ,2009).

This section makes comparisons between what constitutes the standards against what the model prescribes. The standards compared with what the model prescribes and the outcome is presented as a percentage (%) score for the model in Table 43.

Table 43: Benchmarking Model with Quality Rubrics

	Benchmark Factor	Benchmark Indicators	Authors	Model indicators	Model Scores
1	**Course Design**	Course purpose, course structure, communication channels stated, course policy, course prerequisite, instructor introduction, student introduction, expectations for online discussions. Overall learning approach, choice of instructional media, the clustering and sequencing of learning, four key design principles: Consistent layout and design; Clear organization and presentation of information; Consistent and easy-to-use navigation; and aesthetically pleasing design and graphics	Frydenberg(2002).	Course organization, course layout, course structure & course information	100%
2	**Resources for Quality evaluation**	E-learning has five main cost drivers: planning, design and development, delivery, maintenance, and overheads.	Frydenberg, 2002;Swedish National Agency for Higher Education, 2008).	planning, design and development, delivery, maintenance, and overheads.	100%
3	**Web Usability Factors and Quality**	Web usability refers to attributes such as learnability, memorability, efficiency, handling of user errors, and user satisfaction, Pedagogical usability can be placed under four layers: Context specific, Academic & Technical.	Storey et.al(2002),Kukulska-Hulme, & Shield, 2004)	Only user satisfaction n handled	10%
4	**Online Assessment and Quality**	Online assessment to include: written assignments; online discussions; Essays; Online quizzes; Multiple choice questions to test understanding (formative) or as a test (summative) & Collaborative assignment;	Swedish National Agency for Higher Education (2008), Sarrayrih & Ilyas (2013), Jacoy & DiBiase (2006), McCord (2008).		10%

		Examination security in online settings assured through: web cameras, computer identification, and finger scans (biometric authentication). Plagiarism in online assignments, use of Turnitin software, while prevention be achieved through designing Online assessments in a manner that helps to reduce plagiarism such as: varying the nature and frequency of assignments, dividing assignments into their component parts, requiring a range of deliverable products, and insisting on evidence of research and proper citation of sources.			
5.	**Course Technology**	Using different media such as video, graphics, audio, animation and simulation in e-learning can add value by increasing the variety of learning strategies & improve both the online learning experience and students' ability to retain information.	Genden (2005) &Hartsell & Yuen (2006).	Use of multimedia	100%
6.	**Learner Support**	Tutorial support using a diverse range of media for communication, Cost-value assessment and Transparency and availability of information about the course and the structure of the course and flexibility provided.	Ehlers (2004) & Martinez, Torres, & Giesel (2006),	Social and content support.	100%
7.	**Administrative Support**	Technological support; Study skills assistance; Online educational Counselling; Ongoing programme advising & Digital library Access for students with disabilities	Ehlers (2004) & Martinez, Torres, & Giesel (2006)	Orientation academy advice, call center, registration support	60%

8.	**Institutional Structures for Quality in E-learning.**	Provision of quality requires effective and efficient institutional structures.	Quality Assurance Agency for Higher Education (2008).	Infrastructure & policies	100%
9.	**System Review**	Quality enhancement will only take place when the lessons from evaluation are reflected in	Quality Assurance Agency for Higher Education (2008).	Summative & formative evaluation	100%
10.	**Structure of the Virtual Environment and Quality**	internet voice communication, instant messaging, chat groups, emails, blogs, social networking platforms, online video conferencing platforms. *Tools must be is aligned with the technical infrastructure of the institution, and is regularly subjected to internal evaluations, updating*	Stiles (2000) and **Van** & Schepers (2008).	Chats, forums, group work and peer help	50%

- Average score = 73%

4.9.7 Benchmarking Results

From the benchmarking, it is clear that most of the standards are contained in the model except :Web Usability Factors and Quality and Online Assessment and Quality, which is covered by the model at 10% each, Structure of the Virtual Environment and Quality at 50% and Administrative Support at 60%.

The missing indicators, which constitutes about 27% of the standards, include security and plagiarism for assessments, internet voice communication, instant messaging, blogs, social networking platforms and online video conferencing platforms for Virtual Environment; Study skills assistance; online educational Counselling and Digital library Access for students with disabilities for Administrative Support.

The rest such as Institutional Structures, Resources for Developing Quality E-learning, Course Quality Aspects for Students, Instructional Design, Learning Materials, and Course Presentation, Structure of the Virtual Environment, Web Usability Factors, Multimedia use, Learner Support and Online assessment are adequately addressed by the model.

CHAPTER FIVE-ACHIEVEMENTS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter starts by presenting the achievements of the study by systematically reviewing the research objectives stated at the beginning of the study. The chapter evaluates how the study process addressed each of the research objectives and highlights some outcomes that show how the objectives were met. The chapter then gives the final consent and conclusion arising from the study findings.

The chapter proceeds to recount the contributions of the research to theory and practice, brings out some recommendations for future work and gives limitations of the study. The research process was guided by research problem and the research objectives that were stated at the beginning of the study. There were five specific objectives to be addressed. The chapter will try to show the achievements of the study and to confirm whether the study objectives were satisfactorily addressed during the research process.

The five research objectives were:

a) To establish the determining and moderating factors for developing an e-learning system quality evaluation model that is suitable for countries practicing e-learning.

b) To determine the Quality status of JKUAT e-learning system based on the quality determinants established in (a).

c) To utilize the quality determinants established in (a) in modifying Biggs Framework of Quality Education and hence create a tool for reviewing the existing e-learning models and frameworks of evaluation.

d) To derive a comprehensive e-learning quality evaluation model based on other models and frameworks that is suitable for use in countries practicing e-learning in HEIs.

e) To validate the model using Structured Equation Modeling (SEM) and primary data obtained from JKUAT e-learning postgraduate students.

5.1.1 Research Objective One

To establish the determining and moderating factors for developing an e-learning system quality evaluation model that is suitable for countries practising e-learning.

The first gap in the study was identified at the planning stage. Planning which involves Institutional Managers and E-Learning Experts have issues related to determining critical success factors for quality (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014Chawinga, 2016; Kisanga, 2016).

This gap was solved in the study by conducting a systematic literature review in countries practicing e-learning such as: Kenya, Tanzania, Uganda, Malawi, Iraq, Zambia and South Africa. This was followed with an exploratory pre-study at JKUAT. The critical factors identified included: course design and development, content support, social support, course assessment, intuitional factors and user characteristics (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya, 2016; Muuro et al., 2014Chawinga, 2016; Kisanga, 2016).

Although most of these factors are not new and can be used to reinforce existing literature, it is important to note that the roles played by technicians and administrative support are relatively new. Other new factors discovered included indicators such as: lost grades, course structure, assignments and continuous assessments tests.

A paper titled Factors Affecting Asynchronous e-learning Quality in Developing Countries. A Qualitative Pre-Study of JKUAT University (Hadullo, Oboko & Omwenga, 2018) has also been published. The paper describes in details the factors and the quality issues that HEIs practicing e-learning need to rectify as well as making recommendations on how to address the issues by identifying factors that are critical for successful implementation.

5.1.2 Research Objective Two

To determine the Quality status of JKUAT e-learning system based on the quality determining factors established in objective one.

The second gap in the study was identified as a poor quality status of e-learning systems in HEIs currently practicing e learning. Studies show most of the institutions do not have adequate infrastructure, polices, funds, qualified staff, poorly designed courses, poor remunerations as well as low enrolments of students (Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; USAID, 2014; Johanson, Richard & Shafiq, 2011; Aung & Khaing, 2016).

This gap was solved by conducting a case study of JKUAT to investigate the status of its system quality. The study found out that the JKUAT system had both positives and negatives about what institutes a quality system. For instance, JKUAT had a good course layout and course information as well as the frequently provided reminders and announcements for their courses. However, other factors like the structure and organization of the course, constructive feedback use of multimedia, social support, a dedicated call centre, loss or misplacement of grades, lack of training, motivation and incentives for instructors and technicians need to be addressed as they were lacking.

A paper titled: Status of e-learning Quality in Kenya. Case of Jomo Kenyatta University of Agriculture and Technology Postgraduate Students was published for this objective (Hadullo, Oboko & Omwenga, 2018). The paper describes in details the status of e-learning systems for countries practicing HEIs after using JKUAT as a case study.

5.1.3 Research Objective Three

To utilize the quality determining factors established in (a) in modifying Biggs Framework of Aligned Curriculum instruction and hence create a tool for reviewing the existing e-learning models and frameworks of quality evaluation.

The third gap in the study was identified as a lack of a review tool needed for reviewing exiting e-learning models and frameworks of quality in order to determine their suitability for HEIs practicing e-learning. This gap was solved by creating a review tool based on Biggs Framework, which was integrated with quality factors from literature and pre-study.

5.1.4 Research objective Four

To derive a comprehensive e-learning quality evaluation model based on other models and frameworks that is suitable for use in countries practicing e-learning.

The fourth gap in the study was identified as a lack of an evaluation model that fits HEIs particularly in sub Saharan Africa. Evaluation, which involves Technicians, Instructors / Subject Matter Experts, and Evaluation Experts has been experiencing problems related to lack of an evaluation model covering all factors affecting quality as well as procedures for conducting formative and summative evaluation (Khan, 2004).

The fourth gap was solved by conducting a review of five existing e-learning quality evaluation models and frameworks and proposing a comprehensive quality evaluation model suitable for HEIs practicing e-learning. The review tool developed in objective three was used to assess the models and frameworks (P3 model, PDPP model, EQF, TMLE and EMM). The review proved that although the models/frameworks were still suitable for use, they needed to be integrated with other factors and indicators. These factors are summarized in table 44.

Table 44: New and Existing Quality Factors

	Constructs	**Models and Frameworks(Existing)**	**Literature and Pre-study(New)**
1	Course Design	course layout	Course information; Course structure And Course Organization addressed
2	Content support	Content support elements such as multimedia use, accuracy and matching the objectives addressed.	Course structure and organization, announcement and reminders and constructive feedback addressed
3	Social Support	Online library support provides instrumental support for the students.	Information support from peers and affirmation support by working in groups through forums and chats is addressed.
4	Admin support	It is not clear	Course Registration; Academic advice; Campus Orientation; Phone Call Support addressed.

5	Assessment	State e-learning should have assignments, quizzes and examinations.	Lost Grades; Assignment Management; Assessment & Feedback; Assessments & Content.
6	Institutional Factors	Funding;Infrastructure;Policies;culture	Culture
7	Learner Characteristics	Not addressed	Enjoyment; Instructors motivation; computer experience & training on E-learning use.
8	Instructor Characteristics	Not addressed	LMS training, course development training, incentives, workshops/seminars
9	Technician Characteristics	Not addressed	LMS use and customization training, incentives, workshops/seminars
10	E-leaning system quality	User satisfaction; Effective teaching.	Academic performance and cost effectiveness

By combining the existing factors and the new factors, a new comprehensive e-learning quality evaluation model was proposed. This model is represented in figure 16 section 2.8.

A paper published for this objective titled: A Model for Evaluating E-Learning Systems Quality in Higher Education in Developing Countries (Hadullo, Oboko & Omwenga, 2017) describes in details the proposed model.

5.1.5 Research Objective Five

To validate the model using structural equation modeling (SEM) and primary data obtained from JKUAT university e-learning postgraduate students.

The proposed conceptual model needed to be validated using SEM and Regression Analysis through a survey of 180 postgraduate students from JKUAT. The model was validated using SEM and Regression Analyses. The validated Model has five factors of evaluation: course design, content support, social support, administrative support. The evaluation of quality based on the five factors is moderated by: instructor characteristics, student characteristics and technician characteristics (see figure 30 in section 4.9.4).

5.2 Contributions to Knowledge and Practice

The study identified "knowledge gaps" by conducting the gap analysis during a literature review. The researcher has attempted to close these gaps by identifying factors that influence e-learning system quality and creating a model of evaluation. The new knowledge acquired in the process of closing the research gaps are the contributions to knowledge.

The study contributes to the body of knowledge that focuses on e-learning practice by extending Biggs Framework and reviewing five models and Frameworks of evaluation in order to create a new model of e-learning system quality evaluation. The model is then validated and evaluated in JKUAT using postgraduate students. In addition to the theoretical contribution, it provides new knowledge that will make practical contribution to design that is more effective, development and implementation of e-learning systems in JKUAT and Kenya, as well as the associated formulation of e-learning implementation policies and guidelines.

Given the many shared characteristics between HEIs that practice e-learning all over the world and particularly in sub-Saharan Africa, it is apparent that an extension of Biggs Framework to review models and frameworks of evaluation of e-learning in both developing and developed countries and the creation of a new model that is suitable for JKUAT and Kenya will be a good representation of the practicability and applicability of the new model to other countries practicing e-learning.

This Research's contribution to the body of knowledge from Theoretical, methodological, and practical points of view are summarised in table 45.

Table 45: Contribution to knowledge

1.	**Theoretical Contribution**
a)	Formulation an information system theory(ISDT) for the design and support of Information Systems intended to support e-learning. This theory can be useful for both practitioners and researchers. It offers theory-based guidance about how to design and implement quality information systems for e-learning. The ISDT can be used to guide in the development of any technology based model in any domain.
b)	Identification of the factors that influence the quality of e-learning as: course design and development, content support, social support, course assessment, intuitional factors and

	user characteristics (Raspopovic et al, 2014; Ssekakubo et al., 2011; Tarus, Gichoya & Muumbo, 2015; Makokha & Mutisya , 2016; Muuro et al., 2014Chawinga, 2016; Kisanga, 2016).
c)	Extension and modification of Biggs Framework of Quality Learning(Biggs & Tang (2014) using quality factors from literature and pre-study to obtain a review tool that would be used for reviewing existing models and frameworks of quality evaluation. Previously this framework has mostly been applied for studies of quality of face to face education and not for quality of e-learning education
d)	The review of five models and frameworks (P3, PDPP, EQF, EMM and TMLE) resulted in the creation of a new model for studying how to evaluate and use e-learning in a new organizational setting. To the researchers' knowledge, this is the first ever scholarly research study that ever reviewed existing models and frameworks of quality evaluation.
e)	The researchers built a new evaluation model based on other models and frameworks by identifying and validating new factors (constructs and indicators) which impact on e-learning system quality: These new factors are: administrative support, Technician Characteristics, e-learning culture, lost grades, motivations and incentives, delayed examination results, and no CAT marks. The new factors were combined with existing factors in from P3, PDPP, EQF, EMM and TMLE to produce a unique research model with six constructs and three moderating variables.
f)	Overall, the study has led to validation of an e-learning quality evaluation model for application in evaluating the quality of e-learning systems studies in JKUAT, Kenya as well as in other country.
2.	**Methodology Contributions**
	The study highlighted the importance of going through logical steps in undertaking credible research in the area of information system acceptance and use, regardless of the study artifact and organizational context. A summary of key recommendations based on the methodology used in the study is given below:
a)	The researchers should start with the formulation of an information system design theory (ISDT) that underpins the research model. An ISDT is an integrated prescription consisting of a particular class of user requirements (meta requirements), a type of system solution with distinctive features (meta-design) and a set of effective development practices

	(design method) (Markus et al., 2002). Each component of an ISDT can be informed by kernel theories that enable the formulation of empirically testable predictions about the outcomes of the design theory (Markus et al., 2002).
b)	Next in line should be a systematic review of literature aimed at identifying research gaps as well as identifying factors that influence the study objectives. A clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research should be used.
c)	Third, the researchers need to undertake exploratory qualitative pre-study early on at the organization(s) where data is to be collected. The pre-study based on the main study objectives in the information system area of study provides them with important feedback from the main stakeholders on the critical factors for the success of the technology artifact under study. Based on this the researchers are able to relate stakeholders view on factors that influence the quality of e-learning systems.
d)	Fourth, the researchers need to conduct a pilot study. Through the piloting phase the researcher is able to confirm in advance the survey instruments adequacy and obtain focused feedback on how to improve the instruments and thus enhance the chance of obtaining valid and accurate responses. Also important is the ability to use the pilot data to test the conceptual model's reliability and validity and act on the results to improve the model accordingly.
e)	Fifth, the study demonstrates how to conduct a research based on the 'research onion' approach developed by Saunders et al. (2007). It illustrates the stages that must be covered when developing a research strategy. The research onion provides an effective progression through which a research methodology can be designed. Its usefulness lies in its adaptability for almost any type of research methodology and can be used in a variety of contexts (Bryman, 2012).
f)	Sixth, the study sets an example of how to design a descriptive and an exploratory study for evaluating the causal relationships between an endogenous variable and an exogenous variable in a complex study model. The study clearly and in a simplified manner details ow a second generation statistical techniques such as the Covariance Based Structural Equation Modeling (CB-SEM) can be used to validate, estimate and verify a model.

	Justification of a SEM analysis over other approached is provided. Future researchers can benefit from following this methodology.
g)	Seventh, the study goes on to demonstrate how to carry out a CB-SEM analysis using SPSS AMOS by modifying and simplifying the five analysis steps by Kline (2011). A modified flow chart based on sequence of six steps is provided: (1) model specification, (2) model identification, (3) model estimation, (4) model testing, (5) model modification and (6) report results.
3.	**Practical / Managerial Contribution**
a)	By understanding the factors considered to be critical by users in determining the quality of e-learning, management and implementation teams can plan for more effective e-learning systems deployment approaches, including advising system developers on the context specific customization they need to make on their LMS software's to make them more acceptable to the intended users.
b)	Institutional factors emerged as the most pertinent factor that influences the quality of e-learning systems with a factor loading of 0.732. This fully resonates with the findings from the explorative phase of the research where respondents identified a close link between institutional influence such as providing incentives, training, motivation and infrastructure and quality. E-learning managers should ensure that there is a senior-level "champion" or leader to spearhead the use of e-learning systems.
c)	The other factors influencing quality were found to be course design, content support and social support, so implementation of the system should take these into account by ensuring the courses are well designed and supported socially. Furthermore, the complaints raised by technicians and instructors regarding training, motivation and incentives should be addressed.
d)	Although courses assessment emerged as the least important factor based on JKUAT respondents, the management should try and address the issues raised particularly by the students regarding missing grades, some instructors not returning marked scripts and also some giving too many assignments. This together with problem of communication problems experienced when contacting the e-learning center need to be addressed.

5.3 Research Conclusions

In this section, the researcher presents a summary of the key findings as reported in the study.

5.3.1 Factors Determining E-learning System Quality in HEIs

The study discovered that the key factors responsible for determining quality e-learning systems are: course design, content support, course support, social support, administrative support, learner characteristics, instructor characteristics and technician characteristics.

5.3.2 E-learning System Review Tool

The determination of the quality determinants culminated into the development of an e-learning quality review tool based on Biggs Framework of quality. The tool which used the nine factors stated above to modify and extend Biggs Framework was used to review five existing e-learning models and frameworks of quality.

5.3.3 E-learning Quality Evaluation Model

Although the study was conducted in only one university(JKUAT) in Kenya, the results are also generalizable to a greater extent in the context of other countries that practice e-learning. The entire research applied a methodology that assured the validity and reliability of the study findings. By using a survey of scarified sampled 180 students with SEM and Regression Analysis, the validity and reliability of the results were obtained (Saunders et al., 2012) and the measurement model confirmed consistency with the data collected although this was achieved after a little modification with the error modification indices. Therefore, it can be concluded that the model developed in the study is fit to be used by other HES practicing e-learning.

5.4 Recommendations

Although the conceptual model proposed that course assessment would significantly affect the quality of an e-learning system, this hypothesis was rejected from the results of the study. The literature review shows that this hypothesis should have been supported (Biggs, 2007; Chawinga, 2016).

Therefore, there is need to conduct further detailed investigation to establish whether this hypothesis is supported in different e-learning institutions or at different level of study. The study recommends that a study be conducted to investigate the conduct of assessment CATs, assignments and examinations of fully online e-learning students in HEIs.

Secondly, the study was conducted with postgraduate students in e-learning. It would be worth trying to see if the same results are achievable with undergraduate students. Lastly, the study recommends the testing of this model with postgraduate students from other universities to see if similar results can be achieved.

5.5 Limitations of the Study

a) The study focussed on the quality of e-learning system in JKUAT, Kenya and therefore the results may not be generalised to other universities in parts of Kenya or other countries since certain countries may vary between universities in terms of the universities having different social cultural orientations or prevailing legislation.

b) The study data was collected from postgraduate e-learning students alone. The views of Postgraduate e-learning students might not necessarily be the same as those of the under graduate students.

c) The study focussed on the quality of e-learning system in JKUAT which is a public university. The prevailing conditions existing in public universities may not be same as those in private universities making the model not applicable private universities.

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APPENDICES

Appendix A: Data Collection Instruments

a) Students Questionnaire

This questionnaire is to be filled by E-learning students in JKUAT university in Kenya

Correspondent Background:

Course Name: ----------

Course Level: Master's degree [ ] First Degree [ ] Diploma [ ]

Year of Study: Yr1 [ ] Yr2 [ ] Yr3 [ ] Yr4 [ ] Yr5 [ ]

Gender: Male [ ] Female [ ]

Mark using a pen against your preferred choice by a tick (√) or a cross (x)

SD= strongly disagree; D= Disagree; N=Neutral; A=Agree;SA= strongly agree.

Section 1: Course Design

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: Our course is well designed and Course Design quality is improved through course information, course layout, and course structure and course organization:

Table 46: Course Design Questionnaire

No	**Issue**	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Course Design quality is improved through**:**						
a)	Our course id provided by Information about the duration, list of books, availability of instructor					
b)	Information about the course e.g. duration, list of books, availability of instructor(CD1)					
c)	Our course has an attractive and consistent layout improves quality(CD2)					
d)	Attractive and consistent layout improves quality(CD2)					
e)	Our course has Relevant, accurate, complete content aligned to objectives.					
f)	Relevant,accurate,complete content aligned to objectives(CD3)					

g)	Our course has a well sequenced content neatly arranged in headings and sub headings					
h)	Well sequenced content neatly arranged in headings and sub headings(CD4)					

Section 2: Content support

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: our course is well supported and Content support quality is improved through announcements and reminders, use of multimedia, constructive feedback and authentic learning activities.

Table 47: Content support Questionnaire

No	**Issue**	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Content support quality is improved through**:**						
a)	Our course has Announcement & reminders					
b)	Announcement & reminders improves quality(CS1)					
c)	Our course uses multimedia objects					
d)	Use of multimedia improves quality(CS2)					
e)	We get Constructive feedback from instructors					
f)	Constructive feedback improves quality(CS3)					
g)	Our course content material are realistic					
h)	Authentic learning activities improves quality(CS4)					

Section 3: Social Support

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: our course is well supported socially and Social Support quality is improved through announcements and reminders, use of multimedia, constructive feedback and authentic learning activities:

Table 48: Social Support Questionnaire

No	Issue	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Social Support quality is improved through:						
a)	Our course has Information support from peers					
b)	Information support from peers improves quality(CS1)					
c)	Our course has Online library support (instrumental)					
d)	Use Online library support (instrumental) improves quality(CS2)					
e)	Emotional support from family & peers					
f)	Emotional support from family & peers improves quality(CS3)					
g)	Our course has Affirmational support from group work					
h)	Affirmational support from group work improves quality(CS4)					

Section 4: Administrative Support

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: our course is well supported administratively and administrative Support quality is improved through registration support, academic advice support, orientation and providing a dedicated call center.

Table 49: Administrative Support Questionnaire

No	Issue	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Administrative Support quality is improved through:						
a)	Our course has registration support					
b)	registration support improves quality(AS1)					
c)	Our course academic advice support					
d)	academic advice support improves quality(AS2)					
e)	We are given orientation					

f)	orientation support improves quality(AS3)					
g)	Our university has a dedicated call center.					
h)	dedicated call center improves quality(AS4)					

Section 5: Course Assessments

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: our course assessments are well administered and assessments quality is improved through better assignment management, better grade management, timely feedback and clear assessment policies.

Table 50: Course Assessment Questionnaire

No	**Issue**	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Course assessment quality is improved through**:**						
a)	Our course has clear assessment policies					
b)	clear assessment policies improves assessment quality (CA1)					
c)	Our course grades are well managed					
d)	Better graded management improves assessment quality (CA2)					
e)	Our course assignments are well managed					
f)	Proper assignment improves assessment quality CA3)					
g)	We receive feedback on time.					
h)	Timely feedback improves assessment quality(CA4)					

Section 6: Learner Characteristics

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: our learners have the following characteristics and these characteristics improve quality: computer and internet experience, intrinsic & extrinsic motivation and learner-learner interaction.

Table 51: Learner Characteristics Questionnaire

No	Issue	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Learner Characteristics that improve quality are**:**						
a)	I have computer and internet experience					
b)	computer and internet experience improve quality (LC1)					
c)	I am self-motivated to use e-learning					
d)	Intrinsic motivation improves quality (LC2)					
e)	Our instructors motivate us in e-learning					
f)	Extrinsic motivation improves quality (LC3)					
g)	We have learner-to-learner interactions in out courses					
h)	Learner-to-learner interactions improves quality(LC4)					

Section 7: E-learning System Quality

On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: overall e-learning system quality is determined by: cost effectiveness, academic achievements, user satisfaction and learning effectiveness.

Table 52: E-learning System Quality Questionnaire

No	issue	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
e-learning system quality is determined by :						
a)	cost effectiveness (ESQ1)					
b)	academic achievements (ESQ2)					
c)	user satisfaction (ESQ3)					
d)	learning effectiveness (ESQ4					

b) Instructor Questionnaire

This questionnaire is to be filled by E-learning instructors in JKUAT university in Kenya

Correspondent Background:

Qualification: Master's degree [ ] Master's degree [ ]

Gender: Male [ ] Female [ ]

Mark using a pen against your preferred choice by a tick (√) or a cross (x)
SD= strongly disagree; D= Disagree; N=Neutral; A=Agree;SA= strongly agree.
Table 53: Instructors Questionnaire

Section 1: Instructor Characteristics
On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: an instructor characteristic for quality is improved through incentives, training, seminars and workshops.

Table 54: Instructor Characteristics Questionnaire

No	**Issue** e	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Instructor Characteristics that improve quality are						
a)	We are given incentives for e-learning.					
b)	Incentives increases our intent to use e-learning (IC1)					
c)	We are trained on LMS use.					
d)	LMS training improves intent to use e-learning (IC2)					
e)	We have been trained on course development.					
f)	Course development increases the intent to use e-learning (IC3)					
g)	We attend e-learning seminars & workshops.					
h)	e-learning seminars & workshops increases the intent to use e-leg (IC4)					

Section 2: Institutional Factors
On a scale of 1 to 5 (where 1=strongly disagree and 5 = strongly agree), please indicate your perception whether you agree or disagree with the statement: Institutional Factors for quality are improved through funding, policies, infrastructure and culture.

Table 55: Institutional Factors Questionnaire:

No	**Issue**	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
Institutional Factors that improve quality are**:**						
a)	We have good infrastructure such as computers and high internet speeds					
b)	good infrastructure improve quality (IF1)					

c)	We have good e-learning policies.					
d)	have good e-learning policies improves quality (IF2)					
e)	We have an institutional culture that supports e-learning.					
f)	An e-learning culture improves quality (IF3)					
g)	Our e-earning system is sufficiently funded.					
h)	Sufficient funding improves quality(IF4)					

c) Technician interview Theme

Table 56: Technicians Interview Theme:

	A. Technician Characteristics(TC)
1.	Explain the role you play as an e-learning technician in JKUAT. What challenges do you face and how do you handle them?
	a) Are you given any incentives to use e-learning?
	b) Do you believe incentives can improve your intention to use e-learning?
	c) Have been trained on the LMS use?
	d) Do you believe LMS training can improve your intention to use e-learning
	e) Have you been trained on e- course development?
	f) Do you believe course development will improve your intention to use e-learning
	g) Have you been attending seminars and workshops on e-learning?
	h) Do you believe seminars and workshops can improve your intention to use e-learning

Appendix B: Descriptive Statistics

Skewness and Kurtosis for the Models Variables

Table 57: Skewness and Kurtosis for the Models Variables

Construct Definition		Mean	Std. Deviation	Skewness(std error=0.172)	Kurtosis (std error=0.342)
Course Design	CD1	4.47	0.82	-1.711	2.497
	Course information	3.7	0.84	-0.761	0.018
	CD2	4.38	0.83	-1.556	2.163
	Course Structure	3.74	0.816	-0.889	0.371
	CD3	4.44	0.824	-1.735	2.721
	Course Layout	3.26	1.019	-0.08	-1.388
	CD4	4.46	0.838	-1.8	2.83
	Course Organization	2.87	0.965	0.477	-1.337
Content support	Announcement & Reminders	4.09	.968	-.988	.228
	CS1	4.32	.965	-1.449	1.092
	Multimedia use	3.33	1.182	.084	-1.544
	CS2	4.40	.908	-1.653	1.920
	Constructive Feedback	3.22	.987	.127	-1.166
	CS3	4.54	.736	-1.918	3.910
	Authentic learning activities	2.85	1.092	.722	-1.093
	CS4	4.48	.844	-1.858	2.906
Social Support	Informational support	4.45	.837	-1.683	2.313
	SS1	4.50	.821	-1.929	3.607
	Instrumental support	4.19	1.014	-1.060	-.067
	SS2	4.54	.729	-1.774	3.165
	Affirmation support	3.99	1.136	-.759	-.873
	SS3	4.52	.763	-1.815	3.150
	Emotional support	3.98	1.082	-.696	-.827
	SS4	4.49	.833	-1.920	3.500
Administrative Support	Course Registration support	4.12	.927	-.929	.073
	AS1	4.59	.586	-1.565	3.688
	Academic Advice	2.65	1.202	.440	-.762
	AS2	4.55	.608	-1.528	3.762
	Dedicated Call Center	2.35	1.172	1.041	.196
	AS3	4.59	.532	-.770	-.595

	Orientation Support	2.88	1.250	.338	-1.059
Course Assessment	Assessment Policies	4.08	.958	-.750	-.450
	CA1	4.57	.691	-1.940	4.337
	Assignment Management	4.10	.997	-.878	-.322
	CA2	4.54	.736	-1.918	3.910
	Grades Management	4.18	.867	-1.012	.516
	CA3	4.57	.706	-2.008	4.530
	Timely Feedback	3.20	1.330	-.114	-1.329
	CA4	4.55	.714	-1.933	4.135
Institutional Factors	e-learning Infrastructure	3.05	1.090	.333	-1.453
	IF1	4.63	.690	-2.309	5.850
	Sufficient Funding	2.75	1.074	1.054	-.412
	IF2	4.64	.585	-1.855	4.582
	e-learning Policies	3.03	1.145	.458	-1.399
	IF3	4.56	.761	-2.084	4.336
	e-learning culture	2.98	1.147	.644	-1.142
	IF4	4.61	.656	-2.088	5.252
Instructor Characteristics	We are given Incentives	4.62	.599	-1.730	3.901
	IC1	4.64	.560	-1.592	3.459
	E-learning Seminars Available	2.76	1.300	.496	-.971
	IC2	4.65	.566	-1.849	5.002
	Content Development training	2.56	1.317	.625	-.797
	IC3	4.55	.728	-1.990	4.273
	LMS training done	4.34	.667	-.505	-.734
	IC4	4.57	.706	-2.008	4.530
Learner Characteristics	Comp internet experience	3.2	1.16912	0.366	-1.376
	LC1	4.595	0.65813	-2.012	4.953
	Intrinsic motivation	2.14	0.80226	1.569	4.049
	LC2	4.655	0.58967	-2.108	6.002
	extrinsic motivation	2.71	1.32084	0.562	-0.897
	LC3	4.52	0.618	-1.414	3.259
	Learner-to-Learner Interaction	3.45	1.399	-0.508	-1.053
	LC4	4.53	0.6008	-1.31	2.753
Technician Characteristics	We are given incentives	2.7100	1.32084	.562	-.897
	TC1	4.6250	.60515	-1.935	5.020
	We are trained on LMS use	3.2450	1.09130	.273	-1.255
	TC2	4.5900	.65884	-1.987	4.859
	We attend seminars and workshops	2.5000	.70888	1.069	-.226

	TC3	4.5200	.75661	-1.897	3.673
e-learning System Quality	we are satisfied with e-learning	4.03	1.039	-1	-0.13
	ESQ1	4.03	1.039	-1	-0.13
	E-learning mode is very effective	4.6	0.602	-1.791	4.664
	ESQ2	4.6	0.665	-2.03	4.853
	E-Learning mode is cost effective	4.6	0.602	-1.765	4.566
	ESQ2	4.54	0.782	-2.045	4.021
	Our performance has improved with e-learning	4.59	0.611	-1.482	2.363
	ESQ4	4.59	0.643	-1.885	4.482

APPENDIX C:Activity Chart:Gantt Chat

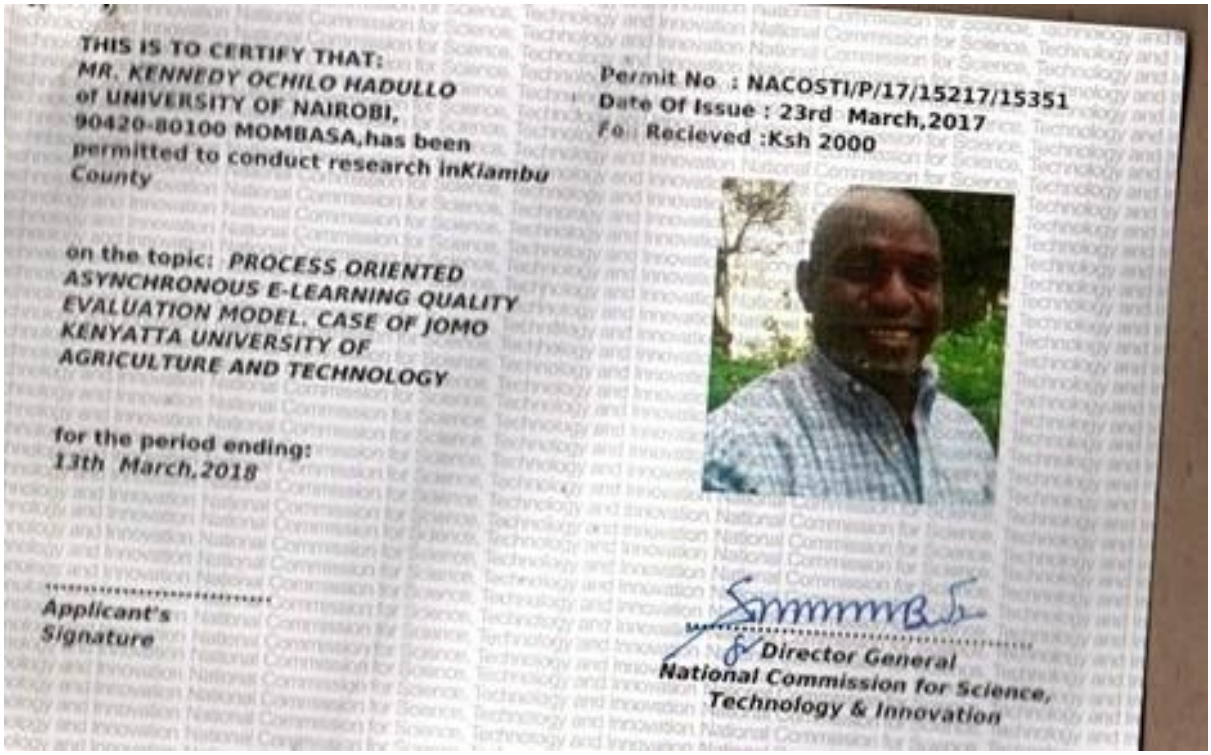
Table 58: Activity Chart: Gantt Chat

MODELING QUALITY E-LEARNING SYSTEM EVALUATION MODEL. A Ph.D. Thesis by Kennedy Hadullo supervised by Prof. Robert Oboko Prof. Elijah Omwenga. School of Computing & Informatics-University of Nairobi												
		2014	2015			2016			2017			
ACTIVITY		SEP-DEC	JAN-APRIL	MAY-AUG	SEP-DEC	JAN-APRIL	MAY-AUG	SEP-DEC	JAN-APRIL	MAY-AUG	SEP-DEC	
1	Proposal Writing											
2	Preliminary Data Collection											
3	Data Analysis											
4	Final Data Collection											
5	Final Data Analysis											
6	Thesis Writing & Submission											

APPENDIX D: Research Documents

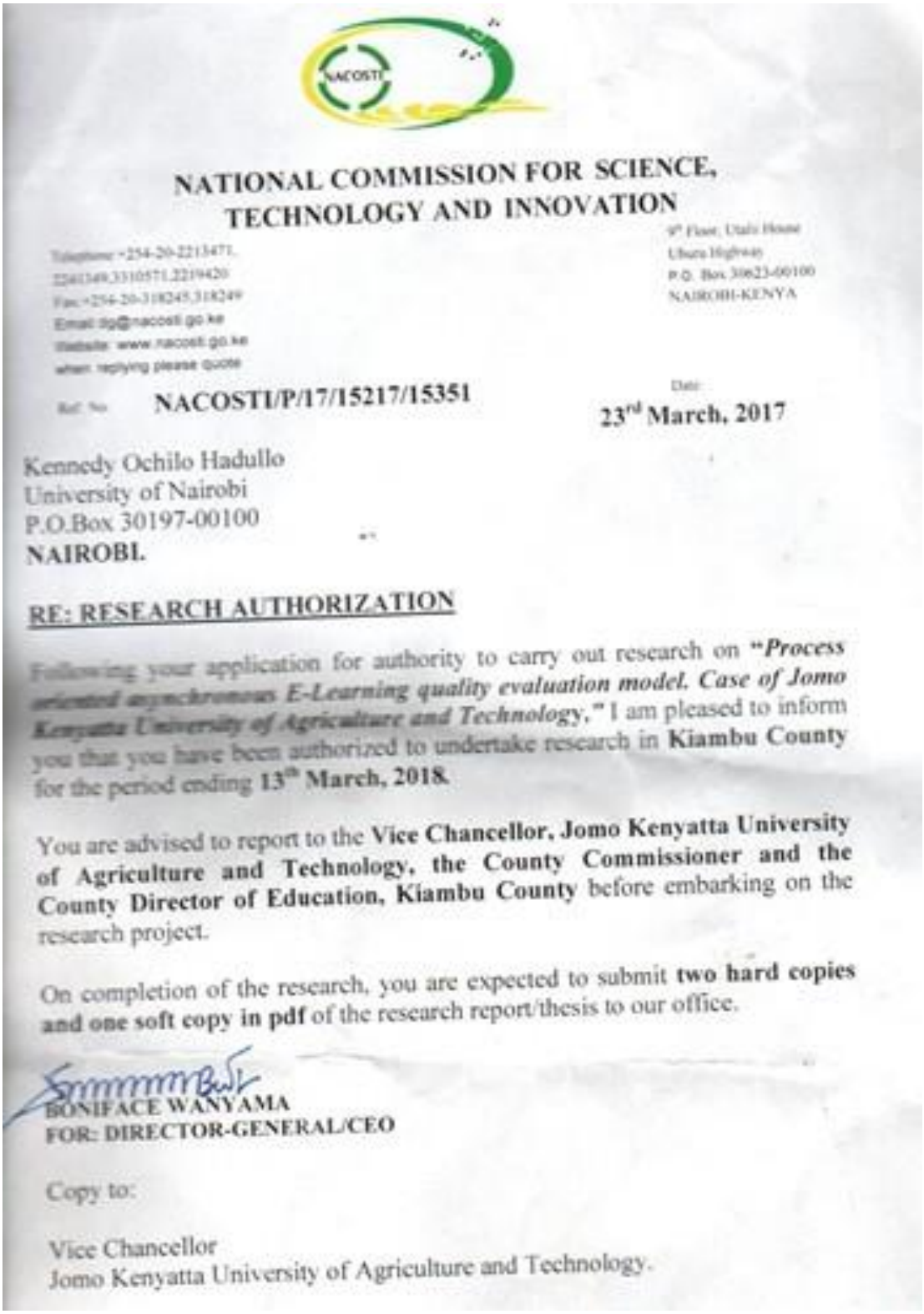
a)Research Permit

Figure 31: Research Permit



b)Research Authorization

Figure 32: Research Authorization



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Telephone: +254-20-2213471,
2241349,3310571,2219420
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
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9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No NACOSTI/P/17/15217/15351

Date: 23rd March, 2017

Kennedy Ochilo Hadullo
University of Nairobi
P.O.Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Process oriented asynchronous E-Learning quality evaluation model. Case of Jomo Kenyatta University of Agriculture and Technology,"*** I am pleased to inform you that you have been authorized to undertake research in **Kiambu County** for the period ending **13th March, 2018.**

You are advised to report to the **Vice Chancellor, Jomo Kenyatta University of Agriculture and Technology, the County Commissioner and the County Director of Education, Kiambu County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

Vice Chancellor
Jomo Kenyatta University of Agriculture and Technology.