ⵜⴰⴳⵍⴷⵉⵜ ⵏ ⵍⵎⵖⵔⵉⴱ
ⵜⴰⵙⴷⴰⵡⵉⵜ ⵙⵉⴷⵉ ⵎⵓⵃⵎⵎⴷ ⴱⵏ ⵄⴱⴷⵍⵍⴰⵀ
ⵜⴰⵖⵉⵡⴰⵏⵜ ⵏ ⵜⵙⴽⵍⴰ ⴷ ⵜⵎⴰⵙⵙⴰⵏⵉⵏ ⵜⵉⵏⵎⴰⴷⵉⵏ
ⵙⴰⵢⵙ - ⴼⴰⵙ
Royaume du Maroc
Université Sidi Mohamed Ben Abdellah
Faculté des Lettres et des Sciences Humaines
Saïs -Fès

المملكة المغربية
جامعة سيدي محمد بن عبد الله
كلية الآداب والعلوم الانسانية سايس –فاس

مركز دراسات الدكتوراه: "اللغات والتراث والتهيئة المجالية"

تكوين الدكتوراه: اللغات والآداب والتواصل

محور: الدراسات الإنجليزية

مختبر: الخطاب، الإبداع، المجتمع والأديان

أطروحة لنيل الدكتوراه في الآداب والعلوم الإنسانية

في موضوع:

The Implementation of E–Learning in Moroccan Higher Education: Engineering Departments as a Case Study

إعداد الطالبة الباحثة: كوثر هني

اسم الأستاذ المشرف: الحسين الوزاني الابراهيمي

تاريخ المناقشة: **20** دجنبر **2021**

لجنة المناقشة:

الدكتور عبد الحميد النفيسي رئيسا

الدكتورة لمياء العزوزي عضوة

الدكتورة كنزة سعداني الحسني عضوة

الدكتور الحسين الوزاني الابراهيمي مشرفا ومقررا

السنة الجامعية: **2020-2021**

DEDICATION

I would like to dedicate this dissertation to my source of inspiration, my loving parents. Thank you for giving me strength to reach my dreams. Thank you for the unwavering support and unconditional love you have been giving me throughout my life.

I also dedicate this work to my dear husband Hicham BELKIHAL who has constantly encouraged me when the tasks seemed arduous and insurmountable. Thank you for believing in me when I could not believe in myself.

I would further like to dedicate this work to my little daughter, my brothers and sister for their everlasting love and warm encouragement.

This dissertation is also dedicated to my mother-in-law and sister-in-law for their unconditional and endless support.

ACKNOWLEDGMENTS

I would like to express my sincerest appreciation and gratitude to a number of people who helped me in the accomplishment of this project. I am first grateful to my supervisor, Dr. El Houcine OUAZZANI IBRAHIMI for his professional guidance, mentoring and motivation and for being available to provide advice at any given time. I am deeply grateful to him for his patience, input and positive criticism and comments throughout the development of my thesis.

I acknowledge the invaluable help of my friends Dr. Hanae AIT HATTANI and Dr. Sanae AMRANI JAI for proofreading my work and for providing suggestions that significantly enhanced the quality of this dissertation. My heartfelt gratitude goes to each one of them for supporting me and being always there when I could not find my way forward.

I would like to make a special note of gratitude to Mrs. Lalla Zhour RZYEK, a Ph.D. researcher for her support and valuable advice. I am thankful to her for the resources she shared and her encouragement and motivation.

I sincerely thank the professors and the students who participated in this study for devoting their time to provide me with their insights and experiences. It is their cooperation and understanding that made this study possible.

I owe unending thanks to my parents, my husband, and my family members who provided endless prayers, constant support and patience during this academic journey.

Finally, I would also like to express my sincere appreciation to everyone who offered me support, encouragement and assistance in the completion of this dissertation.

ABSTRACT

The use of pedagogical and technological innovations in education have altered the ways in which teachers and learners can interact. E-learning as a modern form of education is increasingly adopted in Higher education (HE) and has been one of the main research lines of educational technology in the last decades. Therefore, this dissertation examines the issue of teaching and learning through the integration of e-learning in Moroccan higher education institutions (HEIs), engineering education in particular. Besides, it studies the major factors influencing the implementation of e-learning technology in the Moroccan education system, which is considered a modern teaching approach that can be adopted to improve and enhance students' learning outcomes.

The research investigates the departments of engineering in two higher education institutions (public and private) in Morocco. On the one hand, it evaluates the impact of the use of Information and Communication Technologies (ICTs) in the teaching-learning process, shedding the light on students and teachers' perceptions and attitudes towards the implementation of these new technologies in the classroom. On the other hand, it tries to identify the appropriate teaching methods (classical, integrating the ICT or blended) for the development of the quality of students' knowledge and the professional advancement of teachers of HE. The research relies on the Connectivism and Constructivism theories for a better understanding of the issue

The quantitative and qualitative approaches were applied in this study to get a complete understanding of the use of e-learning in higher engineering education. The quantitative data were collected through a paper-based questionnaire designed for 228 students from the engineering departments as well as an online questionnaire conducted with a sample of 80 university teachers. The qualitative data employed semi-structured interviews with a purposefully selected sample of faculty members who shared their experiences of using ICT in teaching. The collected data demonstrate that the implementation of e-learning is a valuable option to develop an effective and meaningful educational environment; nevertheless, a number of barriers that hinder its successful adoption were identified including poor ICT infrastructure, teachers’ lack of digital skills, lack of teacher training, teachers’ negative attitudes, and absence of technical support.

Key words: E-Learning, ICT, Moroccan Higher Education, Higher Engineering Education, public and private higher education institutions, implementation of e-learning.

مقتضب

أدى استخدام الابتكارات التربوية والتكنولوجية في التعليم إلى تغيير سبل التفاعل بين المدرسين والمتعلمين. وما فتئ التعلم الإلكتروني كشكل حديث من أشكال التعليم ينتشر في مؤسسات التعليم العالي ويشكل أحد التخصصات البحثية الرئيسية في مجال تكنولوجيا التعليم على مدى العقود الماضية. ومن ثم تبحث هذه الأطروحة في مسألة التعليم والتعلم من خلال دمج التعليم الإلكتروني في مؤسسات التعليم العالي بالمغرب، ولا سيما في شعب الهندسة. وبالإضافة إلى ذلك، تدرس الأطروحة العوامل الداخلية والخارجية المؤثرة في تطبيق تكنولوجيا التعلم الإلكتروني في نظام التعليم بالمغرب، وهي التكنولوجيات التي تعتبر نهجا حديثا في التدريس يمكن اعتماده لتحسين وتعزيز ما يحَصله الطلاب من تعلم.

وأُجري هذا البحث في شعب الهندسة بمؤسستين مغربيتين للتعليم العالي (إحداهما عامة والأخرى خاصة). فمن ناحية، تُقيّم الدراسة أثر استخدام تكنولوجيا المعلومات والاتصالات في عملية التعليم والتعلم، مسلطةً الضوء على تصورات ومواقف الطلاب والمدرسين تجاه تطبيق هذه التكنولوجيات الجديدة في الفصل الدراسي. ومن ناحية أخرى، تحاول تحديد الأنسب من أساليب التدريس (الأسلوب الكلاسيكي، أو دمج تكنولوجيا المعلومات والاتصالات، أو الأخذ بهما معاً) لتحسين معارف الطلاب والنهوض المهني بمدرسي التعليم العالي. ويعتمد البحث على النظرية الترابطية والنظرية البنائية حتى يتسنى الإلمام بالمسألة بشكل أفضل.

وأُخذ في هذه الدراسة بنهجين، كمي ونوعي، للإحاطة بمسألة استخدام التعليم الإلكتروني في التعليم الهندسي العالي. وجمعت البيانات الكمية من خلال استبيان ورقي وُجّه إلى 228 طالبا في شعب الهندسة، فضلا عن استبيان إلكتروني على الإنترنت أجري بمشاركة عيّنة من 80 أستاذا جامعيا. واستخدمت البيانات النوعية مقابلات شبهَ منسَّقة مع عينة مختارة عن قصد من أعضاء في هيئة التدريس عرضوا خبراتهم في مجال استخدام تكنولوجيا المعلومات والاتصالات في التدريس. وتبين البيانات المجمَّعة أن تطبيق التعليم الإلكتروني خيار قيّم لتهيئة بيئة تعليمية فعالة وذات مغزى؛ بيد أنه، تم تحديد عدد من الحواجز التي[٧] تحول دون اعتماد هذا النهج بنجاح، ومن ذلك ضعف

البنية التحتية لتكنولوجيا المعلومات والاتصالات، ونقص المهارات الرقمية لدى المدرسين، ونقص تدريب المدرسين، والمواقف السلبية للمدرسين، وغياب الدعم التقني.

كلمات مفتاحية: التعلم الإلكتروني، تكنولوجيا المعلومات والاتصالات، التعليم العالي في المغرب، التعليم الهندسي العالي، مؤسسات التعليم العالي العامة والخاصة، تطبيق التعلم الإلكتروني.

RÉSUMÉ

Depuis plusieurs années, le monde a connu une révolution scientifique accompagnée d'une évolution au niveau des Technologies de l'Information et de la Communication (TIC). Face à ce mouvement, l'intégration des TIC dans les établissements d'enseignement supérieur est devenue essentielle pour améliorer la qualité de l'apprentissage des étudiants et le développement professionnel des enseignants. L'apprentissage électronique en tant que forme moderne d'enseignement est de plus en plus adopté dans l'enseignement supérieur (ES) et a été l'un des principaux axes de recherche au cours des dernières décennies.

Cette thèse examine la question de l'enseignement et de l'apprentissage à travers l'intégration de l'e-learning dans les établissements d'enseignement supérieur (EES) Marocains. En outre, elle étudie les facteurs internes et externes qui influencent la mise en œuvre de l'approche e-learning dans le système éducatif Marocain, qui est considéré comme une approche pédagogique moderne qui peut être adoptée pour améliorer la qualité de l'enseignement et l'apprentissage. Cette recherche porte sur les départements d'ingénierie de deux établissements d'enseignement supérieur (public et privé) au Maroc. D'une part, elle évalue l'impact de l'intégration des TIC dans le system éducatif, en mettant en lumière les perceptions et attitudes des étudiants et des enseignants vis-à-vis la mise en œuvre de ces nouvelles technologies en classe. D'autre part, elle tente d'identifier les méthodes d'enseignement appropriées (classique, intégrant les TIC ou mixte) pour le développement de la qualité des connaissances des étudiants et la progression professionnelle des enseignants de l'ES. La recherche s'appuie sur les théories du Connectivisme et du Constructivisme pour une meilleure compréhension de la problématique.

Les approches quantitatives et qualitatives ont été appliquées dans le cadre de cette étude pour mieux comprendre l'utilisation de l'e-learning dans l'enseignement supérieur de l'ingénierie. Les données quantitatives ont été recueillies au moyen d'un questionnaire papier conçu pour 228 étudiants et un questionnaire en ligne mené auprès d'un échantillon de 80 professeurs. Les données qualitatives ont été recueillies au moyen d'entretiens semi-directifs mené auprès d'un échantillon de 16 professeurs qui ont partagé leur expérience avecl'utilisation des TIC dans l'enseignement. Les données recueillies montrent que la mise en œuvre de l'apprentissage électronique est une option valable pour développer un environnementéducatif efficace et significatif; néanmoins, un certain nombre d'obstacles à son adoption réussieont été repérés comme le manque d'infrastructure TIC, manque de compétences numériques des enseignants, manque de formation, attitudes négatives des enseignants et absence de soutien technique.

Mots-clés : E-learning, TICE, Enseignement Supérieur Marocain, Enseignement Supérieur de l'ingénierie, établissements d'enseignements supérieurs publics et privés, Intégration de l'e-learning.

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	: Analysis of Variance
CAI	: Computer-Assisted Instruction
CAL	: Computer-Aided Learning
CBL	: Computer-Based Learning
CVI	: Content Validity Index
EES	: Établissements d'Enseignement Supérieur
E-Learning	: Electronic Learning
EMSI	: Ecole Marocaine de Science de L'Ingénieur
ENSA	: Ecole Nationale De Science Appliquée
ES	: Enseignement Supérieur
FVI	: Face Validity Index
GENIE	: Generalization of Information and Communication Technologies in Education
HE	: Higher Education
HEIs	: Higher Education Institutions
IBL	: Internet-Based Learning
ICTs	: Information and Communication Technologies
ID	: Instructional Design
IT	: Information Technology
ITS	: Intelligent Tutoring System
MCA	: Multiple Correspondence Analysis
NCET	: National Charter for Education and Training

PBL	: Problem-Based Learning
PCs	: Personal Computers
PICAM	: International Strengthening Program with a Training Mandate
PUB	: Public
PUBT	: Public Teacher
PVT	: Private
PVTT	: Private Teacher
QUAN	: Quantitative
QUAL	: Qualitative
RQs	: Research Questions
SPSS	: Statistical Package for the Social Sciences
SSI	: Semi-Structured Interview
VEL	: Virtual Learning Environment
WBL	: Web-Based Learning

LIST OF TABLES

LIST OF TABLES - *Continued*

LIST OF TABLES - *Continued*

LIST OF TABLES - *Continued*

LIST OF TABLES - *Continued*

LIST OF TABLES - *Continued*

LIST OF FIGURES

LIST OF FIGURES - *Continued*

LIST OF FIGURES - *Continued*

TABLE OF CONTENTS

Introduction: Preliminary Considerations

Introduction

In recent years, the world has known a rapid transition into being a global digital village; Information and Communication Technologies (ICTs) have taken a great role in this transformation. In fact, the development of such modern tools of communication has helped in creating a lot of changes in the community. One of these changes is the educational system that is trying hard to cope with the significant change in todays' educational needs, especially that classical modes of teaching are no more convenient to the learners' requirements and to the social and academic evolution (Harry, 2002). Actually, the digital age requires a fundamental transformation from the education system, especially higher education (HE). Technology is everywhere, it is difficult to think of any part of our lives that does not encompass it. From smart phones to our cars, from work to our residence; technology improves our lives, connects us with information, and makes us more social and close to each other (Pelet, 2013).

The dramatic influence of globalization and the information revolution have positively affected the perspectives of the teaching process. Those factors have made of ICTs a necessity in educational curricula to assure the quality of the teaching-learning operation and to cope with changes that are taking place at a rather rapid rate. Merril (2011) claims that starting from the late 20th century, there has been a worldwide shift in HE which made of ICTs a necessity for academic and professional success, especially that most job opportunities proposed in the business market are linked to modern technologies. Abbott (2003) argues that:

> It is now abundantly clear that the development of information and communication technologies is very different. Schooling and teaching will be forced to change in a variety of ways. At one level, we now have to teach computer skills, not least because career prospects for our students maybe dependent on the possession of such skills. Second, we have to prepare pupils for a society in which many traditional aspects of living have been transformed, aspects which include retailing, banking and communication by means such as e-mail. (p. 11)

ICTs are developing at a fast pace, influencing various parts and domains including economy, education, industry, policy and health. In this regard, man functioned in effective and rapid styles of life, and employed less time to accomplish different missions and performances, the thing that was hard if not unachievable only some years ago (Daugenti, 2009). The modern age witnesses a prominent shift and fast evolution; one category of people believes it is positive, whereas the other concentrates on its gloomy side. This shift can begin from education, since it is the most significant instrument of change (Harpe & Peterson, 2009). One of the important tools presented by ICT is electronic learning, which is a modern teaching approach and "an excellent alternative.… basically stands for all learning using electronic technologies to access a curriculum outside of a traditional classroom…. it has the potential to transform how content is delivered to learners" (Duran & Gonzalez, 2018, p. 310). Accordingly, developed countries have started to prepare their societies for the digital revolution through the integration of e-learning in their education system so as to support and enhance the quality of teaching and learning.

The use of e-learning in education boosts the standard of learning and teaching by prompting learners to ameliorate their performances and to be self-directed learners both inside and outside the classroom; reciprocally, by encouraging instructors in HE settings to fulfil their tasks in better conditions. The integration of ICT in education as a whole becomes a necessity in the information age where teachers and learners require newest teaching strategies for an effective and modern pedagogy (Elhassani et al., 2016).

Electronic learning involves teaching and learning through the integration of educational technology (Freitas & Jameson, 2012), it has reconstructed teaching and learning by making them more suitable and convenient to both students and teachers, mainly that e-learning is not constrained by the concepts of time and place. The recent progress in ICTs has promoted the implementation of e-learning in many higher education institutes (HEIs) around the globe. Actually, in the past few years e-learning has faced a substantial evolution; on the one hand, it is due to the growth of ICTs and technologies, on the other hand it is because of humans' demand for an appropriate instrument for professional directions and not just for pedagogical objectives (Gay, Salomoni, & Mirri, 2007).

E-learning revolution has grown faster and occupied a significant position in the field of education, particularly HEIs, which fulfilled an important standard of education, and ameliorated their abilities in teaching (Harry, 2002). Nevertheless, these advancements were not completely successful because HEIs have faced several challenges and barriers in implementing e-learning; for example, the absence of financial and technological assistance, inadequate ICT infrastructure, teachers' lack of digital skills, and the learners and teachers negative attitudes were the basic factors why many HEIs could not incorporate e-learning into its educational programs (Haghi & Noroozi, 2016).

The primary objective of this dissertation is to identify the different factors that affect the implementation of e-learning in the Moroccan setting and to determine the remarkable role of e-learning in enhancing the standard of higher education, particularly in engineering fields. The paper comes up with propositions for productive fusion of e-learning with conventional teaching practices, at the same time it attempts to examine the teaching and learning methods practiced in two Moroccan HEIs, and to spot out the impediments that slow and block the integration of e-learning in teaching higher engineering education. Although e-learning presents an excellent alternative to HEIs, its application is still a critical challenge due to the complex environment that involves various pedagogical and technological components, particularly in the Moroccan setting.

The selection of this topic is inspired by the fact that in this information age, the use of educational technology principally and e-learning precisely in the classroom has become vital due to its primary role in turning the teaching process into a self-directed learning environment, and in simplifying the move from classical teaching to effective teaching through technology. Nonetheless, technology alone cannot guarantee this shift; lecturers should be qualified to work with technology, since their role will be extended to planning e-learning instructional content and activities in order to perform their tasks in an efficient way. In fact, many university teachers affirm that the integration of e-learning in teaching and learning enhances student's critical thinking, since it encourages them and it goes hand in hand with their demands (Hardman, 2016).

This paper is made up of an introduction, five main chapters, and a conclusion. The introduction establishes the context, purpose, significance, research questions and hypotheses, research methodology, theoretical framework and thesis layout. The first chapter explores the general background of the study and the literature; it paves the way for a better understanding of the research problem and comes up with the definition of the primary key words in order to narrow down the scope of the study. Furthermore, it provides a concise description of e-learning, its evolution, its aspects and a comprehensive depiction of the instructors, students and the teaching methods used for teaching engineering education. Besides, it deals with the theoretical framework of the research and focuses on the most important learning theories.

The methodological design of this research is presented in chapter two; it outlines the research design and the research methodology adopted to fulfil the research. Chapter three presents the results of the paper-based survey administered to university students. Chapter four is devoted to the presentation of findings and data analyses of the web-based survey and the semi-structured interview. Chapter five is dedicated to the discussion and interpretation of findings in the light of the research questions, hypotheses, and the literature review. Eventually, a general conclusion sums up the study findings, shedding the light on some implications, limitations and suggestions for future research.

Accordingly, the purpose of this research is not to define the theories and the instructional approaches or to sum up the findings. It is rather a study that contributes to the field of education in which e-learning is seen as a fundamental element to improve the standard of the Moroccan higher education, as it detects which aspects should be taken into account when using e-learning systems in educational settings. According to Razani (2017), "ICT needsto be integrated into all national education systems in order to realize a higher quantity and quality of education" (p. 2). However, in order to succeed in this task, it is necessary to have a solid institutional commitment and clearly defined political determination. The incorporation of ICT into teachingpractices is of paramount value to developing nations since it offers them an opportunity to transcend inherent barriers and to obtain new resources and develop modern approaches and techniques (Razani, 2017).

Indeed, the adoption of educational technology could be of great significance in promoting Moroccan higher engineering education; however, there are some factors that affect the teachers' motivation to use ICT in the classroom, such as the feeling of being replaced by technology and thus, omitting the traditional means of education (Sangra, Guardia, & Fernandez 2009). Actually, despite the massive role of technology in education, it can never replace teachers but adds to their jobs for perfect results. Lee, Jor and Lai (2005) claim "computer will never replace teachers. But teachers who use computers will replace those who don't" (p. 30).

In general, institutions that incorporate technological innovations and interactive media strategies can develop intensive inspiration for students and it absolutely guides them to achieve innovative ways of thinking. Furthermore, it enhances the nature of their learning sphere as it boosts their personal and interpersonal competencies. Indeed, today's learners are fortunate; the fact that the Moroccan educational system is placing the student at the center of the learning process is a fundamental shift towards high quality education (Ajhoun & Daoudi, 2018)

The main objective of this chapter is to set the context of the research. It starts with a concise historical summary of the Moroccan higher education system, and the ways HEIs are trying to secure a high standard of education through adopting the same effective measures taken by international HEIs all over the world (Ajhoun & Daoudi, 2018). The second section focuses on the rationale behind the study at the same time it provides definitions of the chief key terms of the dissertation so as to ensure a common understanding of the key concepts to the reader. Besides, it communicates the research problem stating the main research questions

(RQs) and hypotheses underlying this dissertation. On the other hand, it presents the theoretical framework underpinning this study and discusses the target population of the research, and the sample size. Lastly, a summary section is provided discussing the main elements of the chapter.

1. Background to the Problem

We are all aware of the fact that the Moroccan education system has known many reforms after independence and particularly in the field of education. Thus, Moroccan higher education institutes have started to submit to this new shift by progressively integrating ICTs into their agendas. Today, Moroccan universities are seeking to grant the needs of the various categories of students who came with varied social backgrounds, from various areas or towns all over Morocco (Ajhoun, Daoudi, 2018). Nonetheless, scholars and specialists in the educational arena confirm that educational change is a continuous procedure that involves various stages, "including many different people in so many different contexts" (Wedell, 2009, p. 21).

Despite the call for ICT adoption and particularly e-learning in the Moroccan education setting, its implementation appears to be gradually progressing, and even in its initial stages due to various factors that prevent its effective integration. Shraim (2018) believes that although some higher education institutions have the will and desire to develop successful ICT programs, they are encountered with the serious challenges of appropriate implementation.

One important condition is the instructors and learner's digital competencies, which have to be examined and evaluated in advance before taking the decision of executing any e-learning systems. In this situation, e-learning necessitates more investigation by professionals and specialists to detect best strategies for its appropriate implementation and thus develop quality education without neglecting the role of the traditional mode of instruction.

2. Statement of the Problem

The research problem addressed in this paper was to determine successful implementation of e-learning to attain high standards in teaching engineering education within Moroccan HEIs, seeing that the 21st century is characterized as being the age of modern information technology (IT) in which learning has formerly begun relying on the employment of digital tools. The study needs diverse elements to be taken into consideration, involving those linked to technology, institution and culture. Thus, students at higher educational institutes are assumed to be armed with the basic digital skills to comfortably use e-learning in learning engineering. International society for technology education (2007) concludes:

> Rapid changes in technology affect every facet of our lives, from the way we conduct business to the social relationships we form. With globally distributed workforces, communication systems, and infrastructures, even the least technologically or economically developed nations are able to experience at least some of the benefits. As the economic and social landscape changes, demands on educators and students shift as well. Although traditional literacy skills are still important, students must master a host of new skills in order to become successful global citizens. (p. 2)

This dissertation aims at offering a comprehensive portrayal of the issue of e-learning adoption and application among the departments of engineering within Moroccan higher educational institutions. Moreover, it tries to identify the potential benefits of employing e-learning technology for the students and the educators so as to realize high standards of educational outcomes, which prepare students well for success in the future. Bourne, Broderson, & Dawant (1995) state “sometimes one feels that the information revolution has touched engineering education perhaps less than other fields, when in fact, engineering education should be in a leadership position to utilize information technology for enhancing learning”(p.243).

Accordingly, the call for new technologies in teaching and learning engineering has become an obligation, because they certainly enhance the quality of education. Besides, they make of students active participants in their own learning; they enable the learners to learn anytime, anyplace, anywhere, “they are the ones making the decisions, directing and managing the process, reflecting on progress, seeking out new information and applying it where necessary. During this procedure they are constructing meaning and developing understanding- they are independent learners” (Lakin, 2013, p. 13).

Actually, adopting and implementing modern technologies into HEIs is not a simple mission. It however needs individual as well as institutional change. Therefore, technology use in education will not be beneficial unless teachers and learners are willing to change (Wang, 2014). This means that in the Moroccan setting, collaboration between teachers and learners is viewed as an essential component in the implementation of e-learning, as well as the institutional development.

3. Rationale of the study

Due to the continuous growth of ICTs, this dissertation aims at examining the current state of e-learning technology in Moroccan tertiary education. More than that, it aims at shedding light of the latter's effects on scientific education particularly the fields of engineering, between those who support the adoption of e-learning and those who refuse educational technology. Wattlington et.al, (2014) state:

> Some teachers believe that technology can spark educational reform and shift roles of teachers and students. However, many anxious educators are still locked into the more traditional role of teachers as deliverers of instruction, and concerned about relinquishing control over the dispensation of knowledge. (p.80)

Today's world is regarded as a small entity due to technology revolution. Now, we can see great transformation in various aspects of life including economy, finance, industry, health, etc. In Morocco, both the public and private sectors of higher education are striving hard to cope with globalization. Kettani and Moulin (2015) add:

> Indifference to ICT and inaction is no longer a choice for developing countries. The viable options are limited: they must either make the needed arrangements for ICT integration to harness its power and seize the opportunities that it offers or continue to ignore ICT and consequently assure the human development costs and legitimacy implications. (p. 40)

Fortunately, the Moroccan government started to feel the need for new reforms to meet the future requirements. Yet, some educational technology researchers view e-learning as a menace to the conventional ways of learning; students thus are seen as being imprudent, inconsiderate, and inactive in front of technology. Nevertheless, studies in many industrialized countries have demonstrated the opposite; e-learning presents an effective tool that paves the way for new prospects for learning and teaching engineering (Krishnan, 2012). Lucido and Borabo (1997) proclaim:

> The aim of educational technology is to enhance the teaching and learning process for both the teacher and the learner. Most of us know that the transfer of knowledge between teacher and learner is not unilateral. Good education sees teaching and learning as interdependent activities. While the teacher instructs, the learner communicates back

> what he/she has learned and the teacher, in turn, learns from the experiences of learners. (p. 4)

This dissertation attempts to evaluate the impact of implementing e-learning in higher education, it highlights the significance of e-learning by following the previous efforts of some prominent countries in the educational arena so as to enhance its quality. In addition to that, it presents a guideline to integrating e-learning in Moroccan higher engineering education. Also, it puts emphasis on the aspects that require development and advancement within HE, with more emphasis on the students and instructors' awareness towards e-learning technology. On the other hand, the research focuses on the learners' new demands and how e-learning can meet their requirements. Actually, the research findings may provide relevant groundwork for better application of e-learning which results in high quality of the Moroccan higher education system.

4. Purpose of the Study

The study aims to investigate the integration of e-learning in Moroccan higher education institutions as a mechanism that enhances the quality of engineering education. Notably, the present study attempts to identify the barriers that impede the use and adoption of e-learning technology by the lecturers and learners, and thus to determine the major impediments that hinder its effective implementation.

The general purpose and motive for this study stem from the fact that investigation in the field of e-learning in higher education is quite restricted in Morocco. Therefore, the present study seeks to develop a comprehensive framework that will eventually lead to effective implementation of e-learning in HE settings. According to Alphin, Chan, & Lavine (2017), "the successful introduction and implementation of e-learning into existing and new units, modules, programs etc. at a HEI can be heavily influenced by its ability and accessibility effectiveness in delivering knowledge (p. 232). Moreover, the study also focuses on the benefitsand drawbacks of adopting e-learning for teaching and learning engineering. The principal objectives of the present research are:

- To identify the usefulness of implementing e-learning technology in the departments of engineering in Moroccan HEIs.
- To assess lecturers and learners' levels of employing technology for learning objectives.
- To investigate the current state of ICT and e-learning in some Moroccan higher engineering institutes.

- To determine the factors influencing the successful implementation of e-learning.
- To detect the linkage between sets of variables (gender, age, institution…etc.) and the adoption of e-learning in Moroccan tertiary education.

5. Theoretical Framework

Behaviorism, constructivism, and connectivisim are learning theories that support the use of ICTs in a pedagogical framework based on the instructor's pedagogy, the content, the learning objectives, and the potential of the learners being taught. Despite not being similar in their views, these learning theories are not mutually exclusive and reinforce each other. The theoretical framework adopted in this study is based on constructivist learning theory and connectivism learning theory, which will be discussed in chapter 2. That is, for the purpose of this study, constructivism and connectivism are the learning theories that will be examined as they influence teaching and learning in the ICT integrated learning environment.

6. Research Questions and Hypotheses

A research question (RQ) is the first step in a research project, it describes what a study seeks to accomplish and defines the focus of the research project. A research question can set limits to find out where to go next and it determines the data needed to gather as well as the methods, the theories, and the methodology used to access the research study (Anderson & Arsenault, 2005). According to O'Leary (2018), "a research question is the bedrock of your project. It defines your investigation, gives both direction and boundaries and keeps you on truck" (p. 17). The following research questions guided the carrying out of this work:

RQ 1: What type of information and communication technologies do engineering students and instructors possess and benefit from?

RQ 2: How do students and instructors use ICT for learning and teaching engineering education?

RQ 3: How competent are the learners and the teachers in employing e-learning technology?

RQ 4: How do students and teachers' variables (sex, age, area of study, type of school) pertain to e-learning use and competencies?

RQ 5: How do college teachers and students perceive e-learning technology in learning and teaching higher engineering education?

RQ 6: What are the perceived educational benefits and opportunities of implementing e-learning technology in teaching and learning higher engineering education?

RQ 7: What are the perceived disadvantages of integrating e-learning in higher engineering education?

RQ 8: To what extent e-learning is manifested in Moroccan higher engineering education?

RQ 9: Is there any difference regarding e-learning readiness between public and private Moroccan HEIs?

RQ 10: What are the factors affecting the adoption of e-learning technology in learning engineering higher education?

Furthermore, the present research paper was designed to test the following hypotheses so as to determine the different factors that may impact e-learning implementation in HE settings.

H1: Several factors influence the adoption of e-learning in the Moroccan education system.

H2: Moroccan university teachers and students have poor ICT skills to embrace e-learning technology.

H3: The adoption of e-learning technology enhances the quality of engineering education.

7. Assumptions of the Study

The researcher assumes that:

- Higher education institutions (HEIs) in Morocco have poor ICT infrastructure and equipment and rarely use e-learning to facilitate teaching and learning processes.
- Universities do not have ICT policies and regulations to ensure e-learning integration across the curriculum.

- Teachers are computer illiterate and are not able to successfully integrate ICTs with their teaching strategies.
- Students are familiar with and capable of using a variety of technological tools.

It is upon these assumptions that the researcher sought to examine the use of e-learning in the Moroccan context, shedding the light on the teachers' experiences with ICTs to facilitate the teaching process. The researcher also assumes that the participants were to provide truthful answers regarding their experiences on the use of ICT to improve teaching and learning.

8. Research Methodology

The nature of this research project involves carrying out a mixed methods approach, which includes both Qualitative (QUAL) and quantitative (QUAN) data analysis since the mixed method approach has a range of benefits. This research study embraces a combination of approaches to gather data in an effort to confirm or reject the hypotheses and to offer tentative answers to the research questions. Therefore, survey questionnaires were administered (web-based and online questionnaires) to obtain quantitative data from the target population, particularly teachers and students from Moroccan higher engineering institutions. Besides, an interview protocol was designed to the teachers to collect further data.

9. Research Population

Based on the nature of the research, the study should be undergone hand in hand with various theoretical and practical profits for a wider population, involving university lecturers and students in two higher education institutions from the engineering departments from the city of Marrakech in Morocco. Key information about those components will be discussed later in chapter 3. Actually, by the end of the research study, the target audience should recognize the following notions:

- How to set up perfect e-learning systems that fit the Moroccan curriculum in engineering departments.
- How to raise awareness among university students of the role that e-learning plays in simplifying and enhancing the way they learn engineering.
- How to motivate college lecturers to employ e-learning for education purposes.

10. Basic Research Terms

The key words will be defined so as to simplify the mastery of the information within this research project. The basic research terms are defined as follows:

E-learning: there is no evident and direct definition of the term e-learning. Buzzetto-More (2007) argues "it is difficult to distinguish the term "e-learning" from terms such as "virtual learning", "technology-based learning", "distance learning", "network learning", "online learning", "multimedia-based learning", web-enhanced learning", "Internet-enabled learning" and similar terms, because there are often used as synonyms. (p.28)

E-learning is generally perceived as learning where the Internet and the web perform a pivotal position. The term is also used in a wide context, especially as learning where any electronic tool is employed, but it keeps out features that belong to "distance learning", since they are not electronic like books. To provide a clear definition of e-learning, a review on the relationships between e-learning and other similar notions (Internet, Web, online learning, and computer-based technologies) is needed (Buzzetto-More, 2007).

Another definition of the term e-learning according to Pelet (2013) is that e-learning is essentially linked to supplying learners with the basic skills to obtain varied learning activities and assignments by employing electronic tools linked to ICTs for the sake of learning. De Pablos, Tennyson, & Lytras (2014) state "e-learning happens anywhere anytime where learning and educational activities are offered the individuals and the groups the opportunity to work online or offline, synchronously and asynchronously via networked or standalone computers and other mobile devices" (p.178). As a result, if properly adopted and integrated, an e-learning system will be absolutely an effective resource for promoting knowledge sharing in academics, institutions and organizations.

According to Friesen (2009), "e-learning, then, designates the intersection of education, teaching, and learning with information and communication technologies. In addition, it gives special emphasis to technologies and practices associated specifically with the Internet and the Web" (p. 4). In fact, e-learning is defined as the teaching-learning approach that employs ICTs to remodel and optimize the teaching and learning operation in HEIs. First, the types of learning that utilize electronic tools like desktop computers, cell phones, tablets, iPads, smart boards, and other technological devices that are employed to transfer information should be standardized in HEIs, as they present new teaching and learning standards. Second, because of its significance, e-learning should be implemented in every HEI as a reaction to the emergence of the information technology as an essential factor driving changes in education (Gay, Salomoni, & Mirri, 2007).

Implementation: Implementation or to implement means to "fulfill or satisfy the conditions of; to perform; to put into effect" (Webster 1981, as cited in Bentzen, 1985, p. 106). The term implementation signifies a call for the application of e-learning with the traditional modes of teaching. It is a concept that covers different procedures from setting new technology systems to the closing stage of obtaining outcomes of the whole process. According to Bourlova and Bullen (2005), implementation is the process of incorporating various learning styles in order that they reinforce each other and act simultaneously for achieving the desired purposes. In other words, implementation stands for the process of implementing e-learning as a supplement to conventional teaching methods in order to improve learning and teaching in higher education.

Therefore, in this dissertation implementation is related to the methods of fusing e-learning with face-to-face learning to promote teaching and learning engineering in HEIs. The expression e-learning implementation stands essentially for addressing e-learning as a pedagogical tool for transmitting knowledge and promoting the teaching and learning activities in HEIs. “E-learning for engineering students, is the kind of learning that complements traditional methods and gives effective experience to the learner. E-learning for engineers is the use of technology to support the learning process which its wide range of application allows increasing quality of information” (Sorial & Noroozi, 2010, p. 162). Both e-learning and conventional methods can be linked to each other, by implementing the effective elements of each one with the other, and by identifying their dissimilarities in order to construct a solid learning environment for the learners’ satisfaction. Moreover, Brooks-Young (2002) refers to technology implementation as:

> An instructional program in which student outcomes are the focus and technology use is woven throughout the curriculum. In this type of program, technology is emphasized on those occasions when it can be used to enable students to work with and understand a concept that might be too difficult, time consuming, or expensive to attempt otherwise. It is also a program in which teachers have ready access to the technologies they need and that is structured to support teachers at various levels of expertise. It is an

> environment where simple competence is not enough, but where all educators are encouraged to look for innovative uses of technology that enable students to approach problem solving using a range of thinking skills and learning styles. (p. 46)

This is the focal point of the following section, which deals with the theoretical framework and its added value to the study of e-learning, and how it grants multiple chances for an effective learning.

Higher education: HE is defined as education after an entire secondary education stage. It is synonymous with tertiary education and "it includes polytechnics, community colleges, colleges where post graduate professional education is provided" (Turner, 2012, p. 7). Thus, Higher education involves the varied types of institutions and programs, which provide education beyond secondary level programs.

Higher education institutions are defined as institutions that provide learning beyond the secondary level programs. "Higher education is a crucial factor, in the economic, social, and political development; it has often been seen as a panacea for quick development" (Agarwal, 2012, p.41) which means that the progression of a country is linked to the advancement of its education, particularly the post-secondary level.

In the case of Morocco, higher education has known a series of instructional, economic, and administrative reform measures for the development of the country. On the other hand, the Moroccan ministry of education is still looking for solutions to address the educational challenges of the new millennium (Ajhoun & Daoudi, 2018). Despite the change taking place in HEIs, "these changes will be driven by economic and market forces which are almost impossible to predict...therefore, the most critical challenge facing higher education leaders is how to develop the capacity for change" (Siran & Tripathi, 2013, p. 69). In fact, the change needs to involve various aspects of the institution so as to realize rewarding outcomes;otherwise the advancement will be delayed if not impeded. Depauw (2019) declares:

> In order to address the complex problems facing society in the 21st century and to serve the public good, universities must be forward thinking, namely adaptive, innovative, and agile; interdisciplinary, interactive, and integrative; and transformative. In preparation for changes in higher education, it is important to prepare our graduate students, especially the PhDs for the evolving higher-education landscape and to

> become the faculty members prepared for the roles and responsibilities of the new modern university. (p.147)

The role of the 21st higher education institutions is very essential; they are expected to pay more attention to their graduate students and to focus more on new teaching approaches so as to strengthen the quality of education. Indeed, assuring quality within higher education is required in the new millennium and e-learning integration in higher education as one of the factors responding to today's challenges (Depauw, 2019).

Engineering: According to Tredgold (1986), "engineering is the art of directing the great sources of power in nature for the use and convenience of man" (p. 73). The given definition includes three related elements; first relating engineering with "the great source of power in nature" or "forces of power", second referring to "the use and convenience of man" or "the benefit of society"; and third mentioning "the art of directing the great resources", which means shaping nature to create necessary things through "a special knowledge and skill relating to natural or physical phenomena". (p.73)

Today, engineering and technology are seen as "the knowledge to manipulate nature to produce products...energy, and services; and the understanding of the manipulation process that seeks to satisfy human social and economic needs and aspirations" (Dhillon, 2002, p.1). Thus, to combine both elements in Moroccan higher institutions would be of great benefit to the interests of education and to society as a whole. The main reason behind the integration of e-learning into education is that it encompasses most of the effective features of the other educational technologies. "It opens life-long learning to people...facilitates dynamic interaction among instructor and learners. In the ultimate, learners will be able to access to learning opportunity anywhere anytime beyond place and time" (Iskander, 2008, p. 526).

11. Organization of the Study

This study is divided into an introduction, five major chapters and a conclusion. The general introduction reflects the background of the research. It lays the ground for understanding the context of the study and offers a general framework for e-learning integration in higher education. This chapter introduces the problem statement and the background related to the research study, as it covers the objectives of the study, research questions and hypotheses, research assumptions, theoretical framework, research methodology, and outlines the organization of the research paper. Moreover, it includes definitions of the most important key terms related to the research study.

Chapter one examines the literature from various perspectives; it is organized into four major sections. The first one introduces a comprehensive depiction of Information and Communication Technologies; it discusses e-learning evolution, definition, features, strengths and weaknesses. The second section sheds light on the students and instructors' characteristics and new responsibilities in the digital age. The third section discusses the teaching methods used for teaching engineering education and offers a clear understanding of the role of assessment and e-assessment practices in the e-learning environment. The last section is devoted to the theoretical framework that underpins the research study. It sheds light on the different learning theories and highlights the preceding experiences of implementing e-learning in Moroccan education and in different nations as well.

Chapter two provides insight into the data collection tools and methods; it grants a thorough description of the techniques and procedures employed in the study. Moreover, it examines the effectiveness and steadiness of the instruments to obtain accurate results. Chapter three presents the results of the paper-based survey. Chapter four offers the findings of the web-based survey and the semi-structured interview. Chapter five discusses and interprets the main research findings. Lastly comes the conclusion of the research study which epitomizes the main findings, implications, limitations, and suggestions for future research, as it leaves the door open for further investigations that address the issue from another angle, since the progress of education requires additional academic research to achieve quality in teaching and learning.

12. Summary

The present chapter provided a comprehensive portrayal of the research problem, objectives, research questions, hypotheses, methodology, assumptions and design; it focused more on the shift that has recently taken place within the Moroccan HEIs. Significantly, the following chapter will offer a profound examination of related literature, and it will address the research from different angles comprising the constituent elements of e-learning technology and its evolution throughout history. There will be more emphasis on the e-learning features and its benefits on teaching engineering. Likewise, it will help the reader figure out the diverse functions of both students and teachers in the e-learning environments. Eventually, the chapter will explore the major learning theories that are expected to influence e-learning; it includes the connectivism learning theory and the constructivist learning theory. Besides, the chapter will highlight some practices, perspectives and opportunities of e-learning in Morocco and in other nations.

Chapter One: Understanding E-Learning

Introduction

The former chapter tackled the main notions pertinent to the research, the research questions and hypotheses; it presented the background of the study and the progressive stages for addressing the issue. The present chapter will examine the literature so as to provide a clear understanding of the topic under investigation. According to Anderson & Arsenault (2005):

> Successful research is based on all the knowledge, thinking and research that precede it, and for this reason a review of the literature is an essential step in the process of embarking on a research study. A review of literature is a summary, analysis and interpretation of the theoretical, conceptual and research literature related to a topic or theme…it generally provides the framework for a bridge between a piece of original research and the work which preceded it. (p. 76)

Actually, the main aims of the literature review are to sum up or evaluate accessible academic and functional knowledge with the purpose of offering responses to a research question, which will give more quality to a particular area of research. A literature review is said to be an effective medium that allows researchers to set up a broad scope of knowledge (Eschenbach, 2017). Dealing with the theme of this research, immense literature has been introduced when attempting to provide a solid definition of e-learning and its theoretical background. Kale, Mehrotra, & Manza (2013) affirm:

> E-learning has become increasingly important in higher education. The development and introduction of a variety of e-learning tools…. has been causing numerous changes in higher education institutions, especially with respect to their educational delivery and support processes…. e-learning has great advantages for institutions, practitioners and students, (p. 598).

E-learning has reshaped education through combining both theory and practice in the teaching process. Despite the fact that e-learning may encounter some impediments, it is considered to be a significant element in the history of tertiary education. The role of reviewing the literature is to control and restrain the repetition of study. It detects to what degree the topic has been addressed and fill in missing or incomplete knowledge. Moreover, it guides the researcher to choose how to approach the study and reach a maximum contribution to the study being conducted (Inyang, 2018).

The first aim of this research is to figure out the significance of implementing e-learning in the Moroccan higher education system. The second purpose is to determine the most important determinants and influences that influence its adoption. The third objective is to be able to recognize the tools that help students enhance their level of learning engineering and promote the work of instructors and their evaluation of the learners. The main objective of this chapter is to highlight the central terms and concepts that support this study, and to provide a thorough review of the literature and the conceptual and theoretical framework developed in the study.

Section One: Conceptual Definitions and Related Issues

1.1. Clarification of Terms

1.1.1. Information and Communication Technologies

ICT is an abbreviation for Information and Communication Technology and has been introduced in academic institutions instead of the acronym 'IT' that stands for Information Technology (Rank, Millum, & Warren, 2011). ICT is based on the utilization of telecommunication tools for particular goals (Business, education, health care, etc.). It is a general term that involves various communication technologies (radio, cellular phones, computer, etc.) that communicate, store, and spread information. Today, various mobile technologies have profoundly affected many aspects of the lives including our way of living, our habits, and the way we work and think, (Mahendiran & Gnanadevan, 2016). They further assume that "the impact of the ICT in each sector of the life across the past two-three decades has been enormous…. as world is moving rapidly towards digital information, the role of ICTs in education is becoming more and more important" (p. 286).

With advances in Internet communications and electronic devices, learners now are capable of accessing and managing information from their smart phones or other technological gadgets. Ventura (2014) states "the use of ICT in the classroom is very important for providing opportunities for students to learn. ICT has become an important part of education for the next generation" (p.36). In fact, educational systems have already started implementing ICT into their curriculum and pedagogy responding to the pressures of the digital age and thus, preparing the citizens for the information society.

In addition to guaranteeing efficient learning and engaging learners in constructing knowledge, technology offers further chances for success (Shelly, Cashman, & Ganter, 2007). By implementing more instructional high-tech tools such as online courses, Interactive White Boards, digital libraries, etc. this may revolutionize the engineering practices, and increase the whole learning experience for the learners of the 21st century. Fox & Hackerman (2003) explain "as information and other technologies become more pervasive in teaching and learning of the natural sciences, mathematics, and engineering, a faculty member's use of such resources is likely to become an increasingly important component of teaching evaluations" (p.30). The following diagram shows the major differences between the conventional classroom and the virtual classroom from various angles:

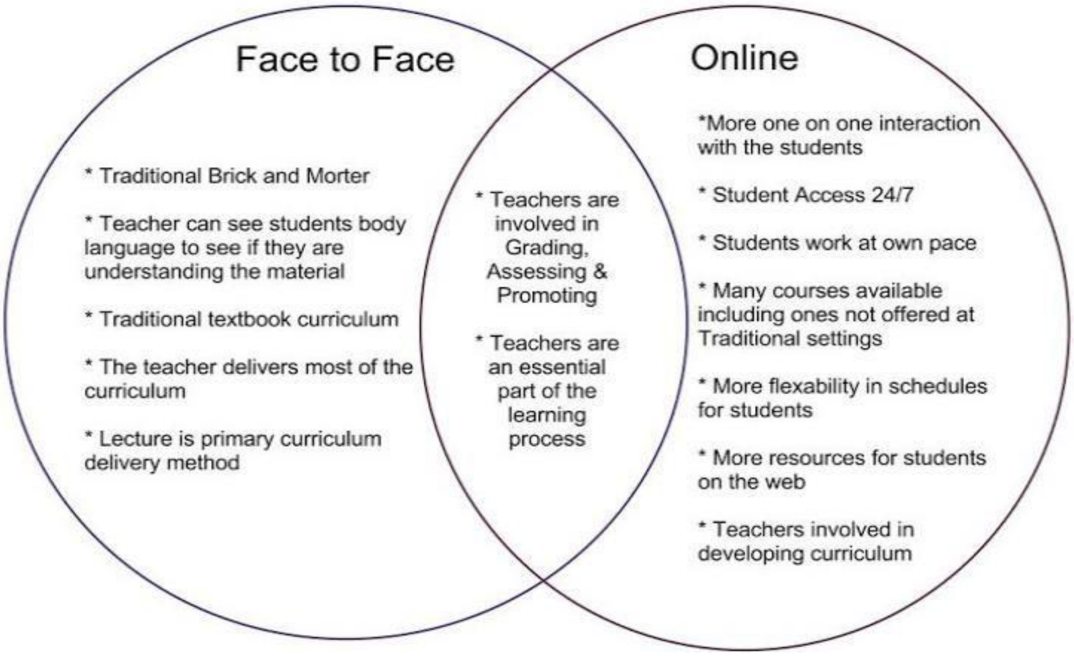


Figure 1. *Key Features of Face-to-Face and Online Instruction.* Source: (Bridget Mondt LEC Portfolio, 2017)

In fact, teaching duties go beyond simply planning and offering courses. Teachers are supposed to engage learners in the process of acquiring and retaining information, and they are expected to support students to become the constructors of their own knowledge. By integrating ICTs in the classrooms, the learners become active participants, they debate, investigate, exchange ideas, provide suggestions, and interact comfortably with each other outside class time. For example, they can revise what they have already dealt with at school via social networks, emails, blogs, etc. Abbot (2003) clarifies "students can look at their grades and even turn in their homework over the Web. Teachers hold online discussion groups.… students are the ultimate knowledge workers. Their 'job' is to learn and explore and find unexpected relationships between things" (p.48).

The adoption of ICT in schools and in higher education institutes appears to be important for both teachers and students. On the one hand, it is beneficial for instructors since it provides them with various tools to plan lessons and design materials for students. On the other hand, it helps learners become active in the learning process and thus, increases their self-esteem. Zhao (2011) highlights:

> ICTs by their very nature are tools that encourage and support independent learning. Students using ICTs for learning purposes become immersed in the process of learning. Thus, teachers and learners are no longer solely dependent on physical media such as printed textbooks which are often times, outdated especially in the developing world. With today's technology, one even has the ability to access experts, professionals, and leaders in the field around the world at any given time. In a world, ICTs enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. (p. 131)

In fact, traditional teaching using the "chalk-and talk" method is considered old-fashioned and outdated as it leads to "one-way flow" of information (Oni, 2012). Yet, as technology has evolved in the past few years, classroom teaching now is using more and more technological tools. For instance, learners can communicate with their instructors and exchange information from home; they can accomplish several Web-based assignments from bed. Eventually, the use of ICT in education has the potential to foster self-centeredness, as it can promote learning outcomes within higher engineering education sector.

ICT has fundamentally affected a significant number of aspects of our lives, including social relations, economy, education, etc. (Grazello, & Kuhn, 2016). It has greatly influenced the system of education in all its forms. In this regard, Chandrakar & Biswal (2006) assume that in the domain of education various types of information and communication media are usedto impart education; they proclaim that "radio, TV, tape recorder, teleconference, fax, telephone, and computer with internet have changed our teaching learning modes" (p. 42). In other words, the implementation of ICT and particularly e-learning has become an inevitable component of contemporary education that tries hard to cope with the new Information age.

1.1.2. E-learning: A New Approach

There are many definitions for e-learning since the term has been used within a broad range of educational contexts. Thus, a precise definition of e-learning is not determined yet as many scholars have diverse views on e-learning discipline, particularly on its field of application (Bartuskova & Krejcar, 2014). The first definition is that e-learning is learning using technological tools as a mean to support the teaching learning process outside of a conventional classroom; it mainly refers to an education or training delivered entirely online (Dron, 2007). The second definition is covered in Bourlova and Bullen’s quote (2005), they state “e-learning is defined as the use of the Internet and Internet-based communication technologies to deliver education and training” (p. 397). Accordingly, the fusion of learning and technology has led to the rise of electronic learning as a mode of disseminating knowledge. In general, e-learning is characterized by the use of Internet technologies in order to support student learning and to enable knowledge without constraints of time and place (Singha, 2009).

Actually, there are various concepts that are seemingly synonymous with e-learning, among these terms we find distance learning, online learning, digital learning, web-based training, and many other important terms. According to Bates (2005), “the terms online learning and e-learning are often used interchangeably, although e-learning can encompass any form of telecommunications and computer-based learning, while online learning means using specifically the Internet and the Web” (p. 8). The above definition makes an obvious distinction between both concepts. DePablos (2008) believes that e-learning is “a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio-and videotape, satellite broadcast, interactive TV, CD-ROM, and more”. (p.783)

E-learning environments are distinct from the conventional classroom where knowledge is originated from the teacher. Nonetheless, it does not mean that e-learning alters the way teachers teach engineering education and the manner learners learn; it is just a sort of technology that strengthens students’ academic achievements, and eliminates obstacles and hindrances that might occur in the traditional classroom instruction (Baporikar, 2013). Moreover, the e-learning course permits trainers to be fully engaged in the learning process, and thus become the central core of emphasis. Banathy (1991) acknowledges that “the learner is the key entity and occupies the nucleus of the systems complex of education” (p.96). Additionally, e-learning is a flexible form of building knowledge; it forms opportunities for learners in terms of where and when to learn. (Khan & Ally, 2015)

Unlike the conventional teacher-centered instruction where learners raise their hands to ask or to answer questions, e-learning offers to students a set of tools to study efficiently without the constraints of time and space. Marinakou & Giousmpasoglou (2014) argue:

> E-learning allows student-centered-learning in which students are able to modify the access and transfer of information, to strengthen the knowledge and skills of students to meet their educational goals (…) In addition, it can support ubiquitous learning and can make the educational process more comfortable and flexible. (p. 182)

Therefore, learners are the ones who construct knowledge with the help and assistance of the teacher. In other words, the teacher becomes more “facilitator” than “provider” or “judge” (Clarke & Madaus, 2012). As a result, e-learning offers many ways to communicate between learners and teachers and among learners as shown in the figure below:

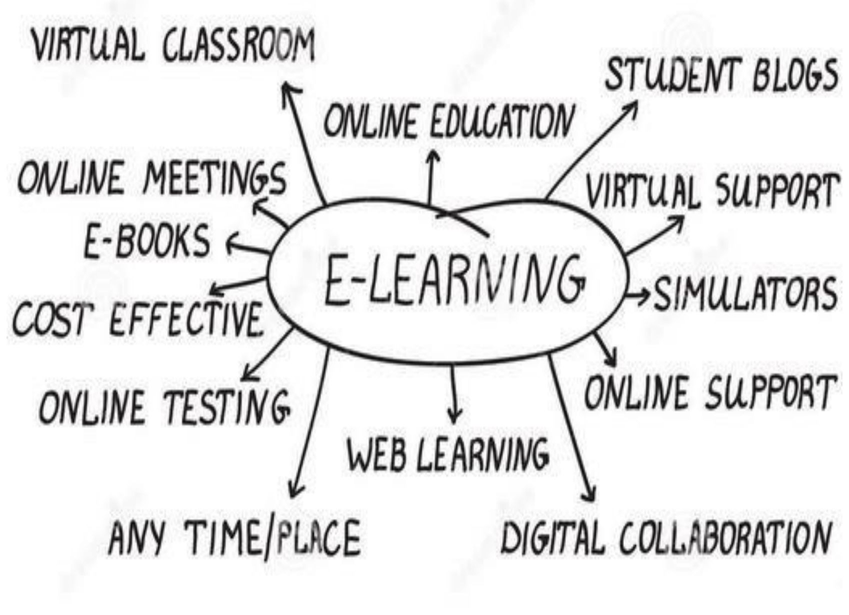


Figure 2. *Features of E-Learning*. Source: website (E-learning Concept, 2017)

The key question is that e-learning has become a promising alternative to conventional instruction methods; it emphasizes learner-centered activities, as it helps students to develop a wide range of diverse skills including interpersonal, cognitive, and communicative skills. The students work together to form ideas, construct knowledge, direct and regulate their own learning. All these processes require digital literacy in order to achieve effective outcomes.

According to Picek & Greié (2013), “e-learning allows access to learning materials at any time and place, and this has been shown to improve students’ learning outcomes, making learning more personalized, and providing opportunities for individualized and collaborative learning” (as cited in Weber & Hamlaoui, 2018, p. 198). By implementing e-learning in education, digital platforms become the main instrument for transmitting information. Consequently, learners will spend increasingly more learning time in front of a computer screen and this might create a kind of isolation for the learners (Kwapy, 2018).

Nevertheless, some professionals and specialists addressed a very important issue that is related to the teachers’ role in e-learning settings, since the instructor-learner communication and interaction may decrease (Elander, 2016), which can be a menace to the people’s well-being in the coming years. The quality of teaching is the core issue since the modern education system was founded; so to improve educational productivity, institutions should search for new methods to deliver knowledge to learners without risking the teaching quality (Veermani, 2010). This is to say that advancing education should not affect the quality of teaching and learning engineering and science. Thus, e-learning should be regarded as an appropriate mean for the support of knowledge creation and quality assurance. The major challenge is to find educational activities to increase the effectiveness of learning engineering, obtaining knowledge, and assessment. MacLoughlin (2012), in this vein, assumes “educational institutions in the 21st century must learn how to adopt social software tools and apply sound pedagogical strategies to add value to existing practices and enhance the learning process” (p. 1). It is becoming obvious that higher education institutions around the world are undergoing dramatic changes in the implementation of modern technologies; it is just a question of time, readiness, and approaching pedagogies to figure out that e-learning has been standardized in all HEIs across the globe. It offers an alternative way for higher educational institutes to deliver knowledge to students (Amilevieius, 2014).

Today, there is a huge demand for implementing e-learning programs in higher educational settings, although the term e-learning is not yet clearly defined. Certain scholars refer to hybrid learning; others refer to technology-enhanced learning, whereas some others choose Online learning (Gay, Salomoni, &Mirri, 2007). Nevertheless, e-learning can be spotted in all the three categories; and this is what makes it flexible and adaptable to cope with the different types of teachers and their methods of instruction.

1.1.3. E-learning: A Historical Evolution

The term "e-learning" has come into use since the mid-1990s as a short form of "Electronic learning" (Friesen, 2009), and it was most likely utilized as a synonym to various concepts such as "distance learning", "online learning", "technology-based learning", "Internet-enabled learning", "virtual learning", etc. The major purpose behind the emergence of e-learning technology was a necessity for a learning environment that meets the needs of different types of learners. With the implementation of e-learning in HEIs, learners who couldnot be able to attend face-to-face classes because of geographic proximity or time restrictions are now able to pursue their educational goals without the barriers of time and place. Due to theadvance of the Internet technologies, the development of e-learning is triggered, and experts inthe field try to discover further pedagogical and cultural chances through employing e-learning. Indeed, investigators emphasize the importance of e-learning technology in educational contexts in the higher education institutions (Freitas & Jameson, 2012).

1.1.4. E-learning: Key Features

E-learning is distinguished by its rapidity, dynamism, and high level interaction of the learner with the content. There exist various software platforms like Blackboard, Moodle, MOOCs and wikis that encompass teaching materials to improve the student learning experience. College students are provided with passwords that allow access to information from anywhere. By logging into their accounts, the students are able to use the online materials, connect with their instructors or colleagues, and complete homework assignments, quizzes, and tests. Likewise, the students stay connected to their classmates and faculty members as if it was in real classroom situations. Bahri (2016) states that "shifting instruction and content online, helps students fill in their knowledge gaps since online learning assists students 'to know', the face-to-face class helps students 'to do and to be'" (p.58). In this sense, there exist four factors leading to students' willingness to use e-learning including the convenience of instruction, the degree of interaction, the degree of combining hybrid methods and e-learning tools, and the equilibrium between life and learning (Penavlo, 2007).

Once the educational context is apparent, components of e-learning and its features must be examined. Badrul (2005) clarifies "components are integral parts of an e-learning system. Features are characteristics of an e-learning program contributed by those components. Components, individually and jointly can contribute to one or more features" (p. 7). The e-learning elements are the tools that constitute the e-learning system. For instance, e-mail is "an asynchronous communication component" that is utilized by learners and teachers to communicate and engage in learning activities. Thus, with convenient pedagogical approaches, e-mail can be implemented in an e-learning course to establish "an interactive feature" between learners and educators. In fact, a well-organized e-learning system can offer various characteristics beneficial to teaching and learning. Nevertheless, these characteristics should be significantly incorporated into the e-learning structure to meet its learning objectives. By adding further components, additional learning characteristics are presented too. As components of e-learning develop as an outcome of the emergence of the Internet and e-learning systems and technologies, actual e-learning attributes will develop and further characteristics may be accessible to us (Badrul, 2005). Different characteristics that are offered by e-learning components are introduced in table 1.

Table 1. *Features and Components Associated with E-Learning Environments.* Adopted from Badrul (2005, pp. 11-12)

E-Learning Features	E-Learning Components	Relationship to Open, Flexible, and Distributed Learning Environment
Ease of Use	A standard and point click navigation system.	A well designed e-learning course can anticipate learners' needs and satisfy their natural curiosity to explore the unknown.
Interactivity	Internet tools, Hyperlinks, Browsers, Servers, etc.	Interactivity in e-learning is one of the most important instructional activities. Engagement theory based on online learning emphasizes that students must be meaningfully engaged in learning activities through interaction with others.
Multiple Expertise	Internet and WWW	E-learning courses can use outside experts to guest lecturers from various fields from all over the world
Collaborative Learning	Internet tools, instructional design and so on	E-learning creates a medium of collaboration, conversaion, discussion, exchange, and communication of ideas.
Authenticity	Internet and WWW, instructional design and so on	The conferencing and collaboration technologies of the Web bring learners into contact with authentic learning and apprenticing situations.
Learner-Control	Internet tools, authoring programs, hyperlinks, instructional design and so on	The filtered environment of the Web allows students the choice to actively participate in discussion or simply observe in the background. E-learning puts students in control so they have a choice of content, time, feedback, and a wide range of media for expressing their understandings.

In addition to that, Li and Liu (2008) point out:

> E-learning has many features such as customized courses, active and interactive learning, learning outcomes and learning process easy-controlled, learning anytime and anywhere and for anyone, transmission to the scattered learners, transmission quickly and timely, learning content easy-archived and easy reuse, etc. (p. 200)

E-learning fundamentally happens in three modes of operation: synchronous learning, asynchronous learning, and virtual classroom learning. Synchronous learning happens when instructors and learners are engaged in learning at the same time during the learning activities, even if they are in two separate locations, i.e. they can be at a classroom or any other place that owns Internet connection. Synchronous learning settings advocate both learning and teaching, provide learners and educators with various modes of interacting, sharing, and the possibility to work together, and exchange ideas or information in real time. Examples of synchronous learning involve audio and video conferencing, Webcasts, live chats/instant messaging, data and application sharing, online slide shows, etc.

The main benefit of synchronous learning is that it is nearer to natural communication since it requires direct feedback (Awofeso, 2018). Asynchronous learning involves learning that does not occur at the same time and location; it is a self-paced and self-directed method of learning that does not necessitate person-to-person interaction during the instruction. In asynchronous learning, there might be certain online interaction between students and teachers; for instance online discussion or online forums where students can post questions at any given moment and teachers provide thorough answers at a later date (Qorbani, Vanani, Sohrabi, & Forte, 2014). Virtual classroom learning includes elements from synchronous and asynchronous learning. In this situation, a course begins and stops at a particular date and time; nevertheless, learners may study autonomously by reaching pre-recorded (asynchronous) resources or interact in real time with their peers and the teacher within a learning setting (Ankomah & Larson, 2014).

Higher education institutions are impacted by the technological, the institutional and instructional changes. Certainly, "there have been high demands placed both on staff and learners to deal with these changes in education, influenced by the rapid development and implementation of information technologies" (Donnelly & McSweeney, 2008, p. 19). They think that the change in education is required because the Internet represents a revolution for the learner and it also changes the way knowledge is delivered and supported. Those determinants of change have prompted researchers to look for new teaching approaches relying on e-learning technology so as to reach an efficient progress for education and society. To sum up, we employ the notion e-learning to refer to the need of a wide range of measures at the educational, administrative, and technical level for the effective integration of e-learning along with more traditional methods (Jochens, Merrienboer, & Koper, 2004). Therefore, all those standards should be taken into consideration once laying out the e-learning content.

1.1.5. E-learning: Potential Benefits and Drawbacks

As far as higher education is concerned, e-learning provides multiple benefits for learners such as free access to the e-learning material from anywhere and anytime by using the Internet as a medium, which is the only condition. At any moment, students can access already existing materials and complete classroom assignments; they can readily revise lessons, follow a series of activities independently, download documents, verify their messages, and share their screens permitting their colleagues to see their work and receive feedback, etc. All in all, e-learning cancels the obligation of physical attendance which permits students to carry out their activities in a more flexible way and proceed at their own pace (King, 2009). Besides, there are various benefits linked to the instructor who gained additional space with the students, the kind of attitudes of being embarrassed to talk in front of a whole class or being humiliated by saying something silly or making mistakes will no longer happen. Feedbacks are provided separately to each learner; therefore, the instructor can readily evaluate their personal work and thus focus on their weaknesses. Educators too choose when and from what place they will join their online classes. They can maintain interaction with learners while they participate in academic conferences, carry out research, or take part in professional trainings (Cookson, 2015). Further advantages are included in the quote of Clarke and Watts-Taffe (2014):

> Many faculty have felt rejuvenated from teaching online and have found that they appreciate the complexity and the intellectual challenge that come with engaging with new ideas, developing new skill sets, and exploring new ways of thinking about teaching and learning. In addition, some online faculty have enjoyed the schedule flexibility, increased efficiency in teaching, opportunities to engage in new technologies, and exploration of getting to know students in different ways. (p.23)

Meanwhile, several universities have begun asking questions such as how to teach and what to teach in e-learning environments. Some academics have already taken some steps of designing courses that involve student-centered learning activities relying on effective traditional materials. E-learning technology keeps producing a great deal of benefits, which permits to turn into a center of attention in educational development (Du, Liu, & Brown, 2009). Some of these benefits are mentioned as follows:

- E-learning enhances the quality of learning and teaching, and strengthens communication and the sense of attachment to a society (Yang, 2013).
- E-learning is an original ready-made platform that combines various elements to meet the learning content, and to simplify the access to the learning materials (Zygouris-Coe, 2013).
- E-learning can determine learners' needs and offer appropriate materials based on learners' styles (Ally, 2008).
- E-learning grants multiple facilities to learners including: accessibility, transcending geographical barriers, and flexibility, allowing them to follow the online courses based on their personal agendas (Orakei, 2018).
- E-learning does not contradict with the conventional face-to-face communication systems; they function side by side in a complementary manner to facilitate instruction and learning (Hui, 2007).
- E-learning helps low-level learners to become active participants by engaging them in the entire learning process (Boswell, 2016).
- E-learning promotes interaction and evaluation for students and educators; it takes into consideration all the components that drive students to total involvement in the learning process (Khan, 2017).
- E-learning promotes dialogue between learners due to the availability of all members' feedbacks (Terry & Folk, 2012).
- E-learning allows self-pacing. For example, the asynchronous learning method enables learners to do research in their own pace and speed. Thus, it enhances satisfaction and reduces stress (Furuness, 2018).

Accordingly, e-learning focuses on different strategies, presents suitable and valid chances for learning interaction, and redefines the roles of both teachers and students. Moreover, e-learning grants an easy use space in which the instructor can classify learners in groups for particular learning goals, which is totally hard if not unachievable in an overcrowded classroom (Pratt & Pallof, 2007). The following figure summarizes the main benefits of e-learning:

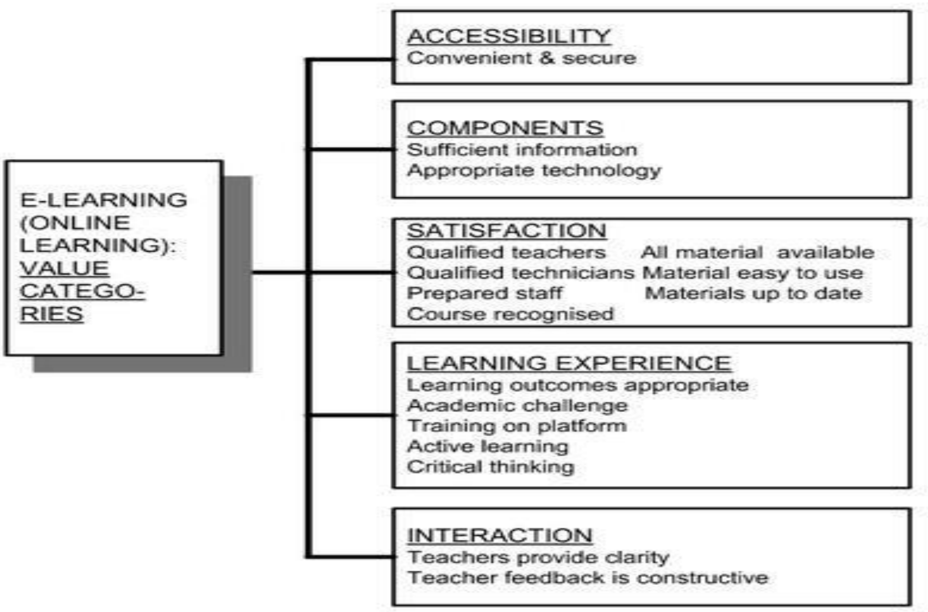


Figure 3. *Main Benefits of E-Learning. Source:* Petrova & Sinclair (2008, p. 118)

On the other hand, e-learning has got some drawbacks which, however, do not hinder the consistency of its goals, including the absence of nonverbal language use, the absence of visual contact, the absence of physical presence, the lack of access for some groups of students and high cost in certain contexts (Bates, 2005). Moreover, "despite the best efforts of setting minimum technical competencies for incoming students, and providing excellent training and online information resources, technical problems will inevitably arise" (Ruhleder & Twidale, 2004). Since it is a new technology for instructors and learners, they may face technical problems with the hardware or software, and Internet connection issues, which can take away from class time. In addition to that, teachers and learners may lack appropriate trainings that pave the way to an effective use of an online platform, and sometimes it is hard to identify convenient programs for certain subject areas. Another limitation expressed by several instructors is that learning via technology is a "calm and impersonal way to teach and can result in a lack of humanness in the instruction delivered" (Terry & Folk, 2012, p.141). The table below sums up the main benefits and drawbacks of e-learning:

Table 2. *The Benefits and Drawbacks of E-Learning. Adopted from NurSyammi & Noraffandy (2010, p.3).*

Advantages	Disadvantages
• Flexible and accessible both in terms of time and place. • Accessible to a wider population. E-learners are able to learn and access materials when there are computers at anytime and anywhere. • E-learning promotes interaction among students since cultural diversity is practiced. • Material can be accessed frequently if something is forgotten. (Hameed et al, 2008)	• E-learning does not encourage social interaction. A person who studies solely will require a great deal of motivation. • E-learners are required to have the computer and internet skills such as communicate, download, view and be tested. • 'Soft skills' cannot be taught via e-learning including the interpersonal skill, verbal skill, communication skill, initiative and leadership skill.

1.1.6. Structure and Design of E-learning Platforms

E-learning platforms are modern e-learning forms that emerged with the advent of the Web. "An e-learning platform is a learning management system which provides integrated support for the six activities- creation, organization, delivery, communication, collaboration, and assessment- in an educational context" (Piotrowski, 2010, p.31). The six activities are defined in the following way:

- **Creation:** it involves the creation of instructional materials by teachers.
- **Organization:** it refers to the organization of the resources for pedagogical objectives.
- **Delivery:** it involves the layout and introduction of the materials in order to be accessed by the learners.
- **Communication:** it refers to computer mediated interaction between learners and teachers and among learners.
- **Collaboration** involves learners working together on specific tasks or activities; it also refers to collaboration between educators.
- **Assessment:** it signifies the constructive and cumulative evaluations of learners' performance.

E-learning platforms were established to offer a unique, regular user interface for all facets of a course. Commonly, the operation of e-learning platforms involves access to learning materials and tests, interactive and collaborative mediums for learners, and course design as well as appropriate assessment for teachers. Various e-learning platforms are accessible nowadays such as “Blackboard, Clix, and Desire2Learn, LearneXact, Dokeos, and the open-source platforms ILIAS, Moodle, OLAT, and Sakai” (Piotrowki, 2010, p. 21). Despite the high standards that several platforms possess, yet advanced nations have not wholly profited from their use by implementing them in HEIs. In this regard, Piotowski (2010) adds:

> The vast array of available e-learning platforms makes it difficult for institutions to select the platform that best suits their needs…. When selecting an e-learning platform, the main questions are which kinds of activities are to be supported by the platform and how well different platforms support these activities. (pp. 21-22)

The platforms may vary in the structure and the design characteristics; nonetheless, they still cover common goals of transferring information and offering pedagogical materials. They involve instructional materials, learning activities, tasks, and assignments introduced in different forms as well as chats and forums. An e-learning platform is an umbrella term that presents a wide array of ICT systems employed to transfer and promote learning. It is designed to incorporate communication and collaboration tools, ensure personal online working area, materials that allow instructors to manipulate and adapt content to learner needs, and grant continuous and accurate monitoring of student achievements. The need for universities and educational institutions to develop certain e-learning courses, which include appealing designs as well as meaningful contents, has become a necessity to reach globalization and achieve high quality education (Piotrowski, 2010). Bianchini, De Antonellis, De Nicola, & Missikoff, (2009) assert:

> E-learning has gained more and more interest to transform and support the learning process ubiquitously. The design of an e-learning system must consider many different perspectives, ranging from the specification of the adopted learning methodology to the organization of learning objects in Content Management System, to the integration of e-learning services in Learning Management Styles, to customization of leaning contents for the involved users. All these perspectives should be taken into account in a consistent manner. (p.81)

E-learning is becoming a prominent long-term strategy for tertiary institutions; it involves various instructional modes and employs appropriate instructional materials so as to achieve an effective e-learning platform. Massive Online Open Courses (Moocs) is one of the most predominant open-source platforms in HEIs (Sapargaliyev, 2014); it contains various course materials and offers collaborative workspaces. It is recently introduced in 2014 as the first MOOC platform in Morocco adopted by the University Mohammed V-Rabat (Ajhoun & Daoudi, 2018). The next e-learning software is named Modular Object-Oriented Dynamic Learning Environment (MOODLE); it is the most widely used learning platform by a growing number of Moroccan higher institutions, as it is the world's most popular learning management system (Qu & Zhong, 2014).

Because e-learning platforms are the means by which the learning content is delivered to learners, they should include four major features (Boneu, 2011):

- "Interactivity": They make learners conscious of their pivotal function in their educational process.
- "Flexibility": Multiple functions that enable the e-learning system to be readily adjusted to the organization where it should be inserted. This adjustment involve the following items:
    - Ability to adjust to the organization's design.
    - Ability to adjust to the organization's learning programs.
    - Ability to adjust to the organization's contents and educational approaches.
- "Scalability": Ability to operate both for a limited or great amount of operators.
- "Standardization": employing standard platforms implies employing courses created apart from the organization, then courses can be accessible not just for the organization that established them, but also others that fulfill the standard; moreover, it ensures the sustainability of the courses, since they are regularly upgraded, and eventually, the student's comportment during the course can be controlled.

Boneu (2011) also provides other general features of e-learning platforms such as:

- "Open code": We make reference to "Open Source" software when it is shared with an authorization to view and change the software's password and other confidential information. The authorization is often accessible to redistribute the password. Nevertheless, Open Source does not definitely imply that a software application must be open; thus, the platform can be adapted based on the current learning motivation.
- "Free platform": The platform does not require a license fee for use. Nonetheless, there are "pay platforms" created by some organizations that merely offer a product for sale.

Such characteristics are of much benefit when setting the content in the platform; on the one hand, the importance of the e-learning platform is mirrored in the productivity of the educational content, on the other hand the favorable outcome of the instructional material is impacted by the sort of the platform implemented. This entails that the platform and the content are mainly interconnected, and that an efficient e-learning implementation depends on these two aspects. The following table identifies the major "criteria" and "guidelines" for e-learning platforms:

Table 3. *"Usability Criteria and Guidelines for E-learning Platforms". Source: Ardito et al., (2004, pp.195-196)*

Dimensions	General principles	Criteria	Guidelines
Presentation	Effectiveness	Supportiveness for Learning/Authoring	For interface graphical aspects, the same UCD attributes hold
			Errors and cues to avoidance are high lighted
		Supportiveness for communication, personalization and access	It is possible to personalize interface graphics
	Efficiency	Structure adequacy	System state is clearly and constantly Indicated
			Progress tracking is clearly visualized
			Possibilities and commands available are clearly visualized
			Course structure is clearly visualized
		Facilities and tech-nology adequacy	Adaptation of the graphical aspect to the context of use is provided
Hypermediality	Effectiveness	Supportiveness for Learning/Authoring	The lecturer is supported in preparing multimedia material
			Easy movement among subjects is allowed by highlighting cross-references through state and course maps
		Supportiveness for communication, personalization and access	Communication is possible through different media channels
			A personalized access to learning con-tents is possible
	Efficiency	Structure adequacy	Both lecturer and student can access the repository
		Facilities and technology adequacy	It is possible to create contextualized Bookmarks
			The platform can be used off-line, maintaining tools and learning context

Table 3. (*Continued*)

Application Proactivity	Effective-ness	Supportiveness for Learning/Authoring	It is possible to insert assessment tests in various forms
			Platform automatically updates students' progress tracking
			Platform allows to insert learning domain tools
		Supportiveness for communication, personalization and access	Users profiles are managed
	Efficiency	Structure adequacy	Mechanisms exist to prevent usage errors
			Mechanisms exist for teaching-through-errors
			Lecturer and students access the repository in different modes
			Platform tools are easy to use
		Facilities and technology adequacy	Adaptation of technology to the context of use is provided
			The date of last modification of documents is registered in order to facilitate updating

1.1.7. The Function of an E-learning Center

According to Thornton and Koech (2017), "an e-learning center is established for serving the learning needs of students, faculty, and staff of an educational/training organization, for the deployment of innovative curriculum pedagogy and state-of-the art learning technology in real courses…. guided by theory and validated by observation of practice" (pp. 73-74). An e-learning center is basically dedicated to educators, and technicians. Instructors who are competent in computer technology can access the learning material on the platform; including PowerPoint slides, lecture notes, essential readings, and other activities such as assessment and tracking. On the other side, the role of the technicians is to offer technical assistance as repairing the most common problems likely to happen in the system. Moreover, "the e-learning centers/units offer training programs, seminars, workshops and presentations by peers to encourage faculty members to use an e-learning approach in their teaching" (Shraim, 2018, p. 326). Accordingly, the e-learning centers will promote the creation of several masses at institutions, where pedagogical experts will examine the suggested learning materials to guarantee consistency with the actual needs and how they fit in with the classroom practice, as well as technological experts who provide expertise and technology solutions to enhance performance and effectiveness (Hever, Groot, & Hoppe, 2009).

Generally, an e-learning center performs many functions; it offers ongoing workshops and trainings for instructors, and tracks thoroughly their contribution in enhancing the e-learning contents. Furthermore, the center guarantees the structure and arrangement of the assignments and activities based on the students demand, in coordination with the designers of the learning materials (educators); it concentrates on improving its learning management systems together with the transmission of the instructional materials. Eventually, an e-learning center "can also include the support to innovate, research, explore, and promote excellence in teaching and learning with diverse technologies" (Repetto & Trentin, 2011, as cited in Thornton & Koech, 2017, p.75).

Section Two: Education and the Information Age

1.2. Key Characteristics of Learners and Teachers in the Digital Age

1.2.1. Learners and Learning

We all know that not every learner is the same; learners learn differently and process knowledge in various ways. Drucker (2011) believes that "learning is as personal as fingerprints- no two people learn exactly alike. Each has a different speed, a different rhythm, a different attention span" (para, 2). There are two main categories of learners in conventional classrooms as well as in online learning environments: committed and uncommitted students. Learners who are committed to gain and acquire knowledge perform continuous engagement in learning activities alongside a positive behavior of curiosity and challenge. In this sense, learners' commitment relates to interest, full engagement, eagerness, and enthusiasm that learners perform when they are involved in the learning process. Krause & Coates (2008, as cited in Kumar & Sundar, 2018) point out:

> Engagement is a wide experience that includes academic as well as selected non-academic and social aspects of the student experience. The methodology of engagement embraces a specific understanding of the relationship between the students and the course creators. The course creators are responsible for creating environments that make learning possible, that afford opportunities to learn. The final responsibility of learning is based on student's effort and commitment towards learning. (pp. 10-11)

The degree of students' commitment depends on obvious objectives, attention, willingness, effort, and the absence of disruptive behaviors. Learners' commitment reflects their readiness to follow courses, complete tasks, respect educator's orientation in learning sessions, and do well on exams. Moreover, Gayton (2015, as cited in Kumar & Sundar, 2018) emphasizes that online students require more guidance and orientation from their teachers and more accurate feedback, which enable them to enhance the overall performance.

The second category of learners is the uncommitted group; it refers to learners who are not fascinated by learning, they do not make efforts, avoid challenges, and are not motivated to participate in learning activities. In virtual classrooms, disengagement may happen because of the absence of some appealing activities, disagreeable conditions, inadequate supervision, inappropriate application, and ineffective restructuring. Learners who are not interested in learning due to internal and external influences are also seen as uncommitted learners.

The primary mission of an efficient e-learning system is to recognize the uncommitted learners, stimulate them, encourage them to connect with the information, and support them fully. Nevertheless, to involve learners in the learning environment, the instructional materials should be developed appropriately. Kosma (2001, as cited in Kumr & Sundar, 2018) believes that "it is not the computer that makes student learn, but the design of the real-life models and simulations, and the students' interaction with those models and simulations" (p. 2).

E-learning system is constantly growing and it needs modern methods to stimulate the learners. In fact, there is a need to ensure that the technology employed in the online learning environment promotes the active engagement of the learners. Watts-Taffe & Clarke (2014) argue "while we may use some wonderful technology tools in our classrooms, we need to be thoughtful about how these tools can be used to position our students as learners" (p. 45). When we employ technology as a learning aid, it is important to consider how these tools operate to involve the learners in the learning process so as to promote active learning. Learners, thus, become self-directed as they have the freedom to choose what to learn and how to learn it; at the same time, they become active participants in their own learning. The students in higher education institutions, particularly, are categorized as mature learners; the majority of them are beyond the age of eighteen, they are more conscious about their educational objectives and able to take control of their own career direction.

It is clear that a great deal of learners nowadays have become technology addicts, Hardman (2016) adds:

> Unlike many of their teachers and their teachers' teachers, today's…. students are tech savvy…. who have never known life without Internet, cell phones, video games, on-

> demand videos, portable computing devices, gaming, and Apps to fit every need. They are socially engaged, tuned in, powered-up and purposefully adept at customizing media to suit their learning needs. (p. 62)

However, students in Moroccan higher education institutions may share common features (Ajhoun & Daoudi, 2018). The factor that makes the teaching-learning process in tertiary education quite complicated and hard for educators and faculty:

- They are from diverse social backgrounds, since they stem from diverse cities and towns.
- They hold some clichés about university teachers and they have some assumptions about the instructional materials, and the learning process in general.
- They might have encountered unfavorable learning conditions formerly whether with the field of study or with the instructor or with the assessment tests; therefore, the future learning processes are adversely impacted.
- They are stimulated by modern forms of learning which grant them some degree of independence in the process of learning, they dislike boring activities and dull classes.
- They can criticize the pedagogical programs, particularly in their final year of studies, and more than that, they dare to criticize the lecturers' mode of instruction.

The given features remain questionable due to the absence of practical case studies; it is also complicated for a university teacher to deal with all these aspects, however being conscious of them simplifies the task for the instructor and thus leads to an effective teaching experience. Learners do not have a single source for acquiring and sharing knowledge; "the barriers to education that may have previously existed are being eliminated, and classroom learning and online learning are starting to utilize many of the same learning resources" (Daugenti, 2009, p. 102). In this electronic age, learners develop new competencies and interact effectively with technology. Once students become conscious of their roles, their duties and rights in the educational process, and particularly how to employ the gained knowledge to promote and enhance their education, the outcome of their advancement in learning engineering becomes visible. The e-learning technology offers them the chance to identify their requirements and orientations.

.

.

1.2.1.1. College Students: Diverse Backgrounds and Abilities

Students' performance varies from one learner to the other; some might excel in some subjects since they own a specific type of intelligence, whereas the others might fail due to many reasons. Gray & Smith (2007) state "while some students are motivated…. to excel, others are disinterested in academic study and fail to achieve their full academic potential" (p.77). Having different motivations puts the learners' needs at the center of the instructional decision-making, and students take part smoothly in the educational process both inside and outside the classroom through e-learning activities. Graham & Hewett (2009) claim:

> E-learning provides opportunities for active learning by including activities that require critical thinking, application of course content, and construction of personal knowledge of the concepts. Students receive immediate feedback on their work, revise, and review, allowing an expansion of the content and process of learning. The e-learning objectives and standards are comparable to in-class objectives and standards without the distractions of student disturbances. Students also realize that the e-learning curriculum is equally as challenging as a traditional classroom, but many times, due to the lack of distractions, e-learning produces better outcomes. (p. 201)

E-learning offers a chance for both instructors and learners to expand the scope of their objectives, in which both sides obtain what they aspire due to the positive outcome of the teaching-learning process (Partee, 2002). Actually, almost all college students possess certain basic computing skills and the majority of them own computers connected to the Internet; however, "not all students are technology savvy, which is a cause of concern, since instructors do not necessarily have the skills or the time to help when students have technical issues. Students' technology skills can range from proficient to novice" (Beisser & Sengstock, 2018, p. 237). Such dissimilarities enable some learners to become adept users of the e-learning systems, whereas others may lose motivation and the desire to learn. Consequently, the choice of an e-learning activity should take into account many criteria including the characteristics of students and the degree of interaction and collaboration necessary for the educational process.

Additionally, through e-learning students can develop many skills and competencies particularly that they are in charge of their won learning. Baron and Goldman (1994) add that "learners who use Web technologies to discuss issues, research questions, and solve problems improve their critical reasoning, problem solving, and creativity" (as cited in Horton, 2003, p.

116). In the context of teaching engineering education, specialists from various institutions around the world who already utilize different forms of e-learning tools within their learning processes believe that such technology promotes learners' interest in their studies, enhance their academic achievement within the discipline of industrial engineering, and essentially enhance the teaching and learning experience (Olivera, Navarro, & Vinuesa, 2012). Nonetheless, for an effective learning result, learners should be aware of their responsibilities in e-learning environments and courses must be designed on the basis of learners "dialogue, feedback, and support" (King, 2009, p. 305).

When the teachers are conscious of the similarities and dissimilarities among students, they can organize the instructional material meaningfully in their programs. While from the perspectives of students, they need to recognize how they acquire information in the best way; if the students are visual, they learn through content that can be seen with their own eyes such as photographs, slide shows, and mind maps that definitely exist in e-learning environments. Moreover, if they are auditory they then learn best through active learning materials such as verbal lectures, whole group discussions, videos in the virtual classroom. On the other hand, tactile and kinesthetic learners learn by doing and moving. Therefore, these are the main types of learners (Mitra, 2012):

- Visual learners: learn through sight, they need to see the learning material and the instructor as well.
- Aural learners: acquire knowledge best through hearing; they are good listeners and talkers.
- Kinesthetic learners: prefer to be physically engaged in the lesson, they learn through touching and moving.

Besides, there also exist other learning styles for processing knowledge: "Analytic" and "Global" (Sabin, 2012, p.90)

- Analytic learners: process information by dividing it into pieces and work in a step-by-step sequence. Such learners like to learn in a methodical fashion and logical manner.
- Global learners: are holistic and gain knowledge from broad concepts without delving into details.

Sabin (2012) believes that "if you balance your teaching between visual, auditory, and kinesthetic experiences, you have a better chance of your students absorbing and retaining what you teach them” (p. 90). Furthermore, she cited four further types of learners according to David Kolb’s learning styles (1985):

- Divergers: students who gain knowledge depending on observation and imagination.
- Accommodators: they learn through concrete experiences; they love doing and acting.
- Convergers: they learn through the practice of theory; they rely on active experimentation.
- Assimilators: they learn through observing and thinking, focusing on theories and ideas

In the light of Kolb’s model, it is important for instructors to develop different teaching methods that will help reach the different learning styles of the individuals. Kozma, Belle, & Williams (1978) claim “understanding these differences will allow the instructor to design objectives, methods, evaluations, and other activities that take into account the variety of individual learners” (p. 67). This implies that lecturers as well as e-learning designers should be aware of students’ diversity so as to develop adequate pedagogical materials.

1.2.1.2. Qualities of an Effective Learner

The meaning of an effective learner may vary among experts and pedagogues, taking into account “the multiple intelligences” theory. For instance, a student can do well in scientific subjects but does not have the same strengths in learning languages, or vice versa. Nevertheless, the term “good learner” cannot be defined without taking into account particular historical, cultural, and social context of the learners’ history (Osborne & Morgan-Klein, 2007). In Morocco for instance, we may mention various qualities of an effective learner:

- An effective learner is well behaved in the classroom. “Quiet when he should be quite. Does what he is told. Talks when he should talk” (Fife, 2004, p. 57).
- An effective learner takes part in the learning process, participates, and completes assignments.
- An effective leaner is self-reliant, and not teacher-dependent.
- An effective learner is willing to actively engage in challenging activities.
- An effective learner is able to use his/her critical thinking skills and makes clever guesses.

According to Katsamani & Retalis (2011), learning activities should take into consideration four main criteria, “Comprehensibility/usability”, “pedagogical neutrality”, “flexibility”, and “interoperability” (as cited in Conole, 2013, p. 161). They further add:

> A teacher, with the aid of a learning design tool is called to orchestrate the learning activities that s/he thinks the students should perform in order to accomplish the desired learning objectives following the principles of a learning strategy. S/he might also need to specify the learning objects, tools and services that will be related to these activities. The teacher should also be able to determine in which order the students should perform the activities, and any conditions, preconditions or rules that might exist. Additionally, there must be flexibility when creating the leaning design. A teacher should be able to revise the design and add activities if s/he thinks that so far hasn’t been fulfilled the scope of the course or remove an activity if s/he thinks that eventually it doesn’t provide something to the learning process or change the rules or the execution order of the activities. (p. 161)

In fact, learning through e-learning technology should be linked to the university curriculum and strategic planning, the designed missions can be integrated intentionally to meaningfully engage learners in the teaching-learning process, and offer them appropriate education and adequate appropriate skills needed for the labor market. Importantly, instructors can give instant feedback via personalized conversations or emails; therefore, communication becomes significant, comprehensible, and efficient compared to conventional educational forms and techniques.

1.2.1.3. Understanding Different Types of Learning Styles

There is no ideal teaching method for teaching all learners, as there is no ideal learning style but a multiple set of learning styles and intelligences (Midkiff & Thomasson, 1993). Certain students grasp the designed tasks in different ways based on their own learning styles. Wilson (2014) confirms:

> As our students become more and more diverse, one-size-fits all education is no longer effective. Students come to you with different learning styles. Most learn well by doing, whereas some prefer to listen; others can’t sit still but can learn standing up. Some won’t read anything unless it is about sport. The best way to find out how your students learn best is to ask them (…) ask your students to tell you which lessons were their favorites

and adjust your strategies to accommodate their preferences. The best way to accommodate their preferences is to design a variety of engaging projects and activities and to provide, whenever possible, an element of choice. (p. 50)

Learners' styles differ from one student to another; the following are the types of learners that the instructors should take into consideration before setting the learning content and objectives (McArdle, 2007):

- Confident learners: they are students who need to know why they are given specific tasks. If they have the chance, confident learners will determine their personal aims and may even participate in directing the learning session. These learners may oppose inappropriate programs or strategies, but they will not criticize qualified teachers.

- Affective learners: it includes students who want to feel that their work is fine and they are doing a nice job. They are impacted by their emotions and appreciate the teacher-student bond. Affective students like to be asked to take part in the learning activities.

- Integrated students: students who believe that learning is relevant to their lives; they are always motivated and prefer to be in charge of their own learning as they need some freedom to fulfill particular activities without much direction and orientation.

- Risk-Taking learners: involves students who depend on acquiring more competences and further knowledge, they prefer to avoid conventional instructional materials and strategies and vary their programs.

In this regard, both educators and e-learning designers in HEIs need to identify students' learning styles as well as their needs to set adequate learning objectives and strategies that lead to an effective teaching-learning process.

1.2.2. Reconsidering the Role of the Teacher: New Missions and Responsibilities

There may be considerable discussion among scholars and researchers regarding the effectiveness of the teaching methods, curriculum, disciplinary tactics, and the teaching and learning approaches; however, there is a concrete agreement about what makes a teacher effective, though these traits are outstandingly expressed (Kottler, Zehm & Kotttler, 2005). Ornstein (1990) states "teaching is a complex act, and no single factor can entirely explain or describe the qualities of a "good" or "effective" teacher; in fact, what works in some situations may not work elsewhere in different school settings with different subjects, students, and goals" (p. 15). Actually, learning in e-learning environment requires a teacher with a 'professional well-defined teaching profile so as to achieve effective learning outcomes. Today's instructors are supposed to know how to transfer knowledge to students using adequate pedagogical tools in different learning settings, which are primarily digital and virtual. According to Jones (2006, as cited in Zygouris-Coe, 2012):

> The rapid growth of online distance education courses requires university faculty to face new challenges and different decisions in the areas of course management and design, delivery, student communication, creation and maintenance of a positive and engaging learning environment, assessment, and use of new technologies. Online teaching and learning place unique demands both on instructor and students. The most successful online course experiences for students and instructors depend on the preparation and expertise of a well-prepared instructor. (p. 98)

Indeed, lecturers are expected to possess a great amount of knowledge besides many sided-skills, teaching expertise, and social and moral competences (Mikolla, 2012). Teaching and learning are no more teacher driven since educational technology depends on a student-centered model that puts the learners and their needs at the center of the learning process.

As an academic profession, teaching requires the completion of various academic tasks: teaching and guiding the learners, carrying out research, tracking students' progress, and assessing their performance and knowledge (Sorin, 2008). However, it is quite hard to determine or specify the role of a teacher in higher education institutes, simply because this role may alter depending on the type of subjects, activities, and the amount of students in the classroom. Knowlton (2000, as cited in Sorin, 2008) explains:

> Rather than filter the access to information, as in the case in the traditional classroom, teachers can recommend additional resources and guide students toward their own discovery. Conceptually, the teacher moves from being in the center of the physical classroom to the periphery of the online classroom. While the environment changes from teachers centered to student centered, knowledge is structured through a cooperative effort involving students and teacher. The teacher is responsible for farming the course and providing resources and opportunities to supplement the students'

> interactions. In their revised role, teachers facilitate interaction by engaging the students. (p.7)

In the electronic era, instructors do no more play the role of constructors of knowledge, by the increased expansion of science and technology students are becoming more skilled than their tutors since they are more sophisticated at knowledge navigation in this new learning paradigm. Certain lecturers will find it hard to deal with students-centered approaches, and particularly when the number of learners taught is huge. Alternatively, roles can change from information provider to a guide, a clarifier, an advisor, a facilitator, an observer, a consultant, and a helper. Dickinson (1979, as cited in Shi & Witte, 2018) states "a teacher's role in self-directed learning is different from their roles in the traditional…. class where the teacher is the only authority source who is responsible for the learner's learning and makes all decisions about what, when and how to learn" (p.119). Being a university lecturer requires a wealth of knowledge about education and its practices, a reasonable level of research skills and to know how to adapt teaching and learning experiences to meet the needs of different learners, these standards help the lecturer to establish an efficient e-learning environment. Garrison (2011) points out:

> The role of the teacher in an e-learning community of inquiry must change-but for the better. In its best sense, the core principles and responsibilities of a traditional educational transaction are translatable to an e-learning context. While effective teaching can take different forms, principles such as clear expectations, critical discourse, and diagnosis of misconceptions are common to both face-to-face and e-learning environments. The responsibilities of teaching in any context are complex and multi-faceted. They include being a subject matter expert, an educational designer, a facilitator, and a teacher. However…the liberating frame of e-learning significantly alters how these responsibilities are fulfilled. (p. 55)

In fact, instructors must be aware of the curriculum development process: how to adapt existing courses and materials to accommodate the learning characteristics and abilities of learners. Lecturers must be aware of the digital resources that can support their teaching practices. They are responsible for managing and monitoring student learning and providing ongoing feedback. Significantly, instructors should be experts in their understanding of the process of learning. They need to know how to adapt their teaching styles to better match the diversity of their students. They should be flexible when setting up a learning environment appropriate for the 21st century (Martin-kniep, 1999). Instructors who are open to change develop new skills, strategies, and philosophies. They are open to new experiences in which learners are active constructors of knowledge rather than passive receivers. With the emerging trends, driven by the rise of contemporary information technologies, teachers' role has shifted from "controllers to facilitators who help to promote the learners' meaning construction" (Zhang, 2011, p. 210). Shifting roles of the instructor, from someone who provides knowledge to someone who counsels and facilitates, makes the process of implementing e-learning in HEIs easier than anticipated. The new e-learning environments require a range of skills and competencies on the part of teachers to enhance the quality of education (Ragan & Schroeder, 2013).The following figure shows the expanded roles of the teacher in e-learning systems (Kai, 2019, p. 9):

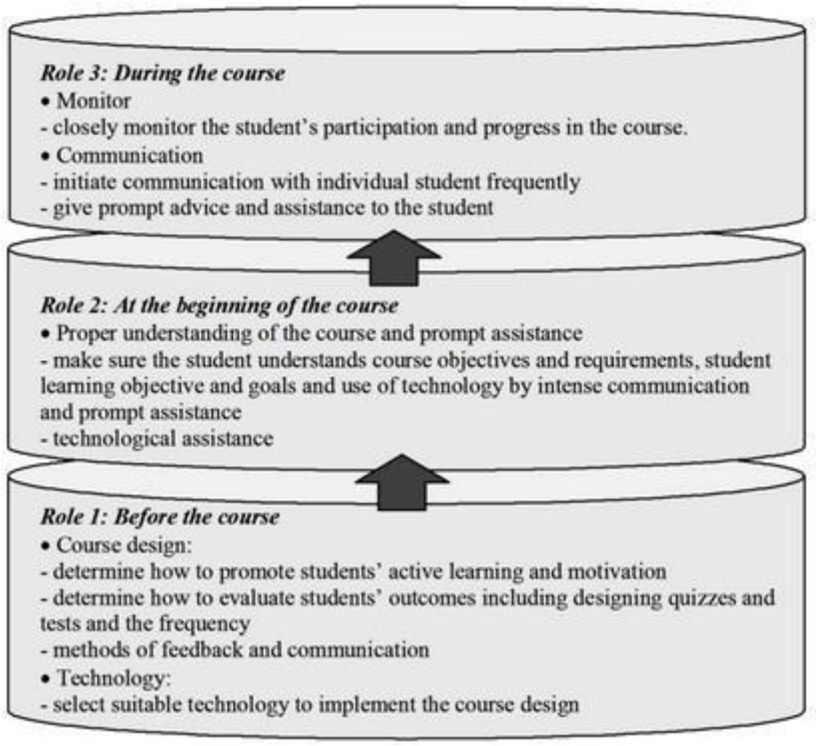


Figure 4. *Faculty Roles in E-Learning Systems.* Adopted from Kai (2019, p.9)

1.2.2.1. Facilitator of Classroom Experience

Rather than being a constructor of knowledge, an effective teacher is the one who facilitates the process of learning and allows the learners to co-construct the lesson. S/he is the one who offers guidance when it is needed. Such a role of being a "guide on the side" motivates students to learn material independently or within a group and avoids the "chalk and talk" function which basically engages talking and dealing with learners as empty vessels to be filled with knowledge and skills (Liminiou, Lyons, & Schermbrucker, 2015). Zygouris-Coe (2015) affirms:

> The 21st century teacher's role is that of a facilitator of students learning, similar to that of an orchestra conductor. There is a shift…. from 'sage on the stage' to 'guide on the side'. All content area teachers should help all students access, build, generate, analyze, evaluate, synthesize, create, and disseminate knowledge. (p.6)

1.2.2.2. Intervener in the Learning Process

An intervener's function is to mediate between the learners and the learning environment, thus enabling access to knowledge (Kennedy, Latham, & Jacinto, 2015). A teacher as an intervener describes the learning environment to the learners as well as simplifying learning and the development of skills. Being an intervener requires also, on the part of an instructor, being constantly attentive providing adequate feedback to learners. This is why it is beneficial for the instructor to observe learners' performances and decide when intervention is necessary. The teacher intervenes to assist learners in completing the assignment effectively and in working together efficiently. In the context of teaching engineering education "the teacher as a 'discourse guide' acts to a considerable extent as an intermediary and mediator between the learners and mathematics, in part determining the patterns of communication in the classroom, but also serving as a role model of a 'native speaker' of mathematics" (Pimm 1987, as cited in Setati, 2005, p. 83).

1.2.2.3. Designer of Learning

One of the assigned roles for every college instructor is being a designer of the lesson either in conventional learning settings or in e-learning environments. When an instructor develops a well-designed Internet activity, s/he seeks to develop an activity that involves as many as possible of the following elements (Nelson, 2008):

- An activity is totally related to curriculum frameworks and curriculum guides.
- An activity is planned to promote profound understandings.
- An activity is associated with students' learning experiences.
- An activity is stimulating but manageable.
- An activity has sense and objective.
- An activity generates curiosity in learners.
- An activity grants options or a feeling of option.
- An activity embraces the multiple intelligences.

- An activity is a chance for cooperative learning.
- An activity grants instant feedback.
- An activity offers time for contemplation and thinking.
- An activity reaches a specific outcome.
- An activity provides a set of assessments using guidelines and goals.

1.2.2.4. Evaluator of Students' Performance

Being an evaluator is a necessary role in any HEI; it is linked to the structure of the system and the assessment of the student's performance and the advancement in engineering education process (Valiulis &Valiulis, 2009). Therefore, it is quite natural that the majority of learners expect from their educators, either by correcting or providing feedback or testing them in various manners. Moreover, a significant challenge that faces teachers is oral evaluation of learners in a crowded classroom; the most widely used method by most instructors is providing written evaluation, which is more equitable for all learners (Frankland, 2007). According to Gong (2011), assessment is:

> A very important part in the process of teaching, and it is not only the students after the completion of a learning process of their evaluation of knowledge and ability to grasp the situation, but also check the level of teachers and teaching effectiveness, check the problems in teaching, feedback teaching and learning process in a variety of information, incentives for teachers to improve student learning and teaching methods have an important role. (p. 363)

Actually the information age brings with it new roles, tasks, competencies and challenges for teachers. The following table presents the different roles of teachers in the new digital era:

Table 4. *Teachers' Different Roles in E-learning. Adopted from Salmon (2009, pp. 890-891).*

Quality/ Characteristic	I Confident	II Constructive	III Developmental	IV Facilitating	V Knowledge Sharing	VI Creative
A **Understanding of online process**	Has personal experience as an online learner, flexibility in approaches to teaching and learning Empathy with the challenges of becoming an online learner	Is able to build online trust and purpose for others. Understands the potential of online learning and groups	Has the ability to develop and enable others. Acts as a catalyst, foster discussion, monitor understanding and misunderstandi ng	Knows when to control groups, when to let go, how to bring in non-participants, when to pace discussion and use time online	Can explore ideas, develop arguments, promote valuable threads	Is able to use a range of approaches from structured activities to free-wheeling discussion, and to evaluate and judge their success
B **Technical skills**	Has operational understanding of software in use reasonable keyboard skills: is able to read fairly comfortably on screen, good, regular, mobile access to the Internet.	Is able to appreciate the basic structures of the CMC and the WWW, and Internet's potential for learning.	Knows how to use special features of software for e-moderators. Knows how to "scale-up" without consuming inordinate amount of personal time.	Is able to use special features of software to explore learner's use.	Creates links between computed-mediated communicat ion (CMC) and other features of learning programs.	Is able to use software facilities to create & manipulate conferences and to generate an online learning environment.
C **Online communication skills**	Provides courteous and respectful online (written) communication, able to pace and use time appropriately.	Is able to write concise, energizing, personable online messages.	Is able to engage with people online, responds to messages appropriately, is appropriately "visible" online & manages students' expectations.	Is able to interact through email and conferencing and achieve interaction between others, is a role model.	Is able to value diversity with cultural sensitivity, explore differences and meanings.	Is able to communicate comfortably without visual cues; is able to diagnose and solve problems and opportunities online.
D **Content expertise**	Has knowledge and experience to share, willingness to add own contributions.	Is able to encourage sound contributions from others, knows useful online resources for their topic.	Is able to trigger debates by posing intriguing questions.	Carries authority by awarding marks fairly to students for their participation and contribution.	Knows about valuable resources (e.g., on the www) and refers participants to them.	Is able to enliven conferences through use of multimedia and electronic resources.

1.2.3. Teachers' Performance in E-Learning Environments

Much has been written about technology and its implementation in teaching and learning settings, but less has been said about what the instructors and students do in e-learning systems. Unlike traditional classroom learning, e-learning is easily accessible and does not oblige learners to move to a particular place. Teaching through e-learning should be considered as a recent setting or milieu for instruction, not only as a means; it allows learners and teachers to maintain dialogue and discussion through software applications and enables students to access learning material all day and every day (Salmon, 2011). Certain instructors are attracted to e-learning since it is the modern tendency of current education, therefore, they like to keep up with the latest developments; whereas others are just compelled to use it. The majority of teachers possess few to no idea concerning what is associated with e-learning, considering it similar to what takes place in the traditional physical classroom and, once they test, they encounter what Mezirow (1990) calls a 'disorienting dilemma' since they break into a world which is strange to them (Pallof & Pratt, 2011). In the e-learning environment they discover that their skills and dependence on what they have regularly performed as educators is far from what they can depend on to help them create the required shift. Instructors are worried that not all that they are dealing with-or assigned to perform- may be adequate for e-learning. The following are opinions of teachers about this matter (Sorin, 2008):

(1) I think what we are doing is putting the cart before the horse there. We are coming up with the modules or the requirements and direction that the online classroom is supposed to be based on what has been historically the classroom environment, and I think that there is not enough thought processes going into it, what is going on online. (p.62)

(2) There is a lot of learning that I still have to work on as to what works well in an online course that may be completely new concepts or may be alterations to techniques used in a classroom environment. What may be very effective in class but not as effective using the identical structure online, where it has to be somehow tweaked, modified, to work well in the online. (p.132)

(3) My skills online are not where I want them to be. So I feel I'm definitely more effective in the classroom. However, I would like to be as effective online and I hope to be that way down the road when I develop the skills and learn more about taking a lot of logistics out of it and just make it applicable to the learning experience. (p.132)

As mentioned earlier, there are some instructors who consider teaching through e-learning as being equal to traditional on-ground instruction; yet they are aware of the fact that as online instruction keeps increasing, it will carry more chances and challenges. Instructors are aware that in order to do well in instructing online, they need to adjust to a new environment and try out new skills to successfully deliver information to the learners. As instructors are involved in the e-learning environment, they constantly assess its potential impact. They raise issues about this setting's features and measures, and how it impacts their instruction and their performance as educators (Sorin, 2008).

The roles and responsibilities assigned to university teachers in e-learning environments can be considerable. Instructors experience high-level stress to adapt the e-learning content, tools, and materials to accommodate students' diverse learning styles and abilities than in the conventional physical classroom space (Shanker & Hu, 2008). In some cases, the creation and design of an online course can pose challenges to teachers. For particular subjects, certain instructors state that they are not yet persuaded that e-learning is operating. A further existing issue is the class size. Teachers participating in instructing huge classes have a sense of frustration as it negatively impacts their teaching potential. It is very hard for educators to monitor learners' performance online just like they do in face-to-face classroom settings.

Ultimately, whether in traditional or online instruction, teachers perceive themselves as valuable contributors to the process of learning. They serve many roles, not just the one of transmitting knowledge. The role they serve in the online environment becomes more effective by definition; as enablers, they encounter the teaching requirements that are either special to the online setting or increased by it. This involves requirements linked to or deriving from classsize issues, variety of performances, learner assumptions, expectations established by school systems, student stimulation, evaluation, course planning, and education development programs concerns. Instructors find some of the requirements as advantageous, whereas others are much harder to conceive. Some of the most significant requirements stated are shown in the following figure (Sorin, 2008):

Figure 5. *A General Equilibrium Model of Teaching Requirements in E-Learning Environments.* Adopted from (Sorin, 2008, p. 134)

Therefore, certain instructors consider teaching as being equivalent to transmitting knowledge. They think that there is more organization online, and they adapt their instructional methods accordingly. However, not all courses can be delivered online similarly, and ICT support differs depending on the sort of activities required. There exists a particular level of "showmanship" in the physical classroom, which is much harder to reproduce in online settings. Instructors consider online education to be inferior to traditional courses since it hinders their attempt of establishing rapport with the learners (Reo & Ortega, 2013).

In this context, in identifying best practices in e-learning settings, it is very important to consider the following factors as reported by Pratt & Pallof (2007):

- Training for online instruction must be promoted in order to enhance teachers' knowledge, to provide them with appropriate skills, and to work on their digital competences in order to be able to use e-learning effectively.
- Adopting the idea of teacher education, through participation in academic certification programs ensuring that university teachers obtain professional training in successful practices for e-learning.
- Reconsidering face-to-face instructional content: by planning adequate material depending on already available traditional instructional materials.

- Embracing adequate teaching strategies through establishing regular workshops and meetings among teachers to discuss the most effective methods and techniques.

Those are the essential components for effective instructors who are conscious of their roles, and how they can fulfill these roles and how they execute them thoroughly (Moise, Suditu, & Netedu, 2012). Sorin (2008) points out:

> When teaching, the instructor plays many roles: he or she can be a coach, facilitator, conductor, director, mentor, tutor, or provider. Whatever their roles may be, teachers strive to help students. Some teachers feel that their effectiveness online is reduced, that they are more effective in the classroom. Teachers are honest about their technology skills. They feel that proper training is essential to help them take advantage of its potential, and they are eager to learn how to use technology…. When teaching online, in response to the demands they face, teachers make certain adjustments to how they teach. For example, they may spend more time preparing the questions provided to students, to compensate for the slower speed of interaction; in addition, they may find themselves adjusting how they monitor their online students. Teaching online requires teachers to work harder to motivate students. (p. 135)

All in all, a good college teacher imparts knowledge (source), assists learners (enabler), leads them (conductor), and evaluates their performance (assessor). These diverse roles can readily be applied to the instructor in e-learning for engineering education, where the teaching-learning process emphasizes student centeredness. Electronic learning, thus, can have huge impact on learning engineering education than conventional communication tools do, and the instructor's roles might be multifaceted based on the goals of the addressed course (Katz, Thomas, & Tront, 1995).

Section Three: Teaching Engineering Education in the 21st Century

1.3. Engineering Pedagogy in Higher Education: From Old To New Paradigms

Engineering is associated with knowing and dominating the materials and powers of nature for the sake of mankind. Thus, engineers examine and develop problematic system operations either by adjusting material that is already available to new requirements or incorporating and managing new support systems (Moeller & Sitzmann, 2012). Accordingly, engineering learners need to study the basics and certain current issues of various engineering fields including software engineering, chemical engineering, civil engineering, energy engineering, and industrial engineering that are provided in available conventional engineering and computer engineering curricula. Nonetheless, in the ever-changing world of technology, the future of higher education depends heavily on innovation, highly qualified skills, and creative minds of engineering practitioners. This requires a new set of skills and competences used to teach the engineering labor force of the modern age, particularly, how to promote improved learning opportunities in engineering curricula. To guarantee that engineering practitioners will fulfill these challenges, it is necessary to extend the methods employed in teaching engineers (Chang et al., 2011, as cited in Moeller & Sitzmann, 2012). Jeschk et al. (2005) claim:

> Providing effective, efficient education and training in the engineering domains, online learning, better known as e-learning, has become a state-of-the art approach to ensuring that engineering students understand the complexity of technological innovations at the level of detail that is required for Research and Development (R&D) issues. (As cited in Moeller & Sitzmann, 2012, p. 196)

Conventional instruction for engineers has changed towards modern learning practices as a result of the ongoing growth process of new information technologies. The constant evolution in technology allows the achievement of a further distributed structure of information transmission. Thus, to realize these standards, new teaching methods and techniques are required in addition to a vast array of resources: professionals should be capable of imparting and distributing engineering tools, adjusting and reviewing them to meet the individual requirements. However, electronic learning in engineering education still encounters many hindrances that impede an identical growth rate. For efficient and successful learning in engineering, science and technology, engineering education needs both theoretical and empirical approaches. Thus, to realize how theoretical information can relate to real world issues, empirical practices are indispensable (Noroozi, Valizadeh, & Sorial, 2010). Moreover, engineering software is always quite costly and cannot be reached by all students. Even though other inexpensive options that use free programs have been effectively established and examined, hands-on laboratories that promote engineering education remain hard to be established online (Magoha & Andrew, 2004 as cited in Noroozi, 2010).

The information technology revolution has been considerably altering the learning-teaching experience of engineering education. ICTs are appropriately considered as instruments that are fundamentally altering the educational process. "Universities, institutions, and industries are investing increasing resources to advance researches for providing better and more effective learning solutions" (Campanella et al., 2007, as cited in Haghi &Noroozi, 2016). One of the primary challenges for teaching engineering education is that it emphasizes learner's centeredness and autonomous learning for an effective learning process. The following figure presents the most essential features for engineering instruction:

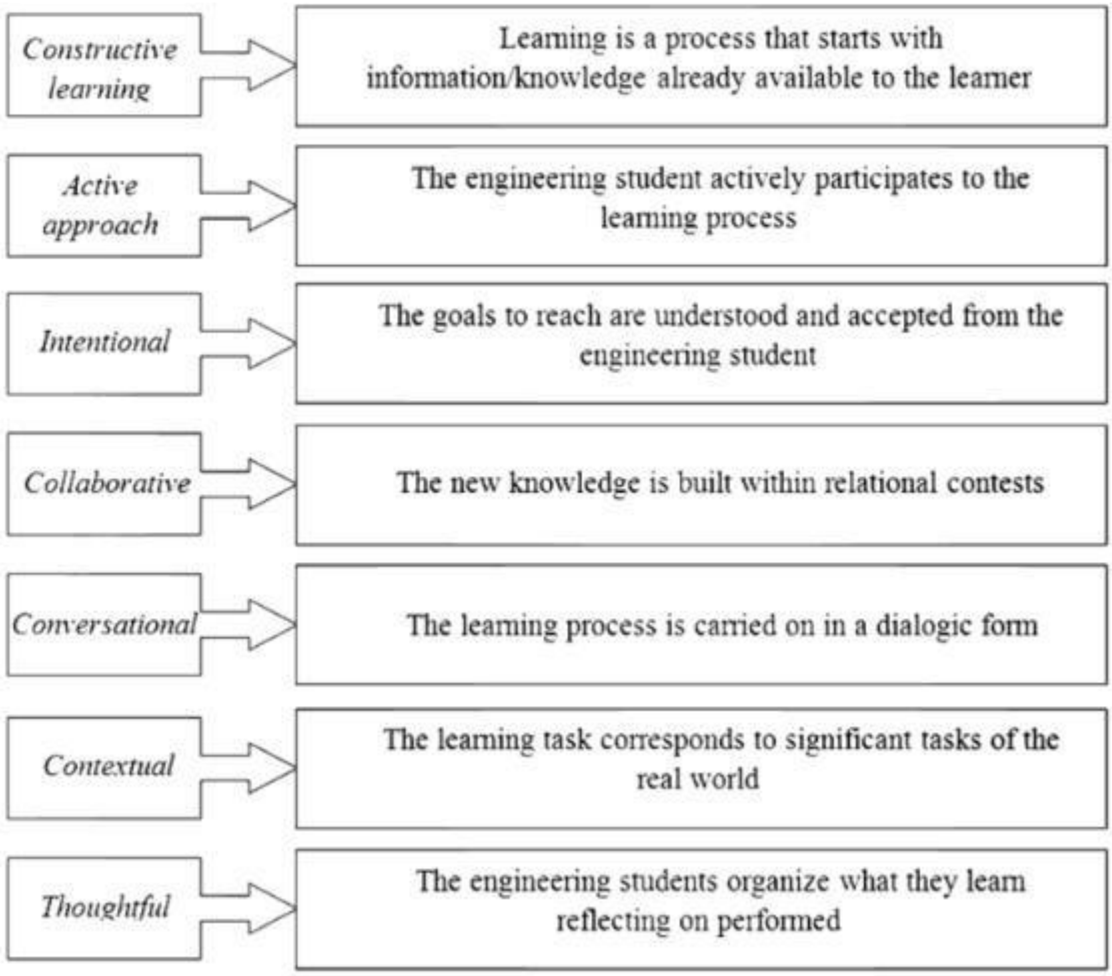


Figure 6. *The Most Essential Features for Engineering Instruction*. Adopted from (Haghi & Noroozi 2016, p. 3)

The major goal of learning engineering education is to achieve three essential learning objectives (Haghi & Noroozi, 2016):

- To teach the engineering learners to be in charge of their own learning and to be able to direct processes to fulfill goals and to realize their learning requirements.

- To support and enhance significant learning settings and experiences, allowing the engineering learners to acquire knowledge and construct information through diverse learning methods and techniques; and
- To design appropriate educational materials and learning activities which serve the acquisition of knowledge.

In these modern times, the implementation of ICTs has enhanced teaching and learning, particularly when conjoined with student-centered teaching approach or convenient education that promotes various modes of interaction between instructor and learner (Danaher, Gururajan, & Hafeez-Baig, 2008). The table below presents comparisons between e-learning and traditional engineering instructional methods:

Table 5. *Difference between E-Learning and Traditional Engineering Instruction.* Adopted from (Noroozi, Valizadeh, & Sorial, 2010, p. 9)

E-Learning	Traditional engineering learning mthods
It can relies on learners' and it is self-motivation	Lecturer always plays a leading role in motivating and directing the engineering students
Assessment of examinations conduced at learners' place	Assessment and examinations time does not depend on learners
Greater achievement is expected in number of students going through engineering courses	Learner restricted to those attending university or college
Innovative methods required to reach practical assignments and experiments	Laboratories readily available for practical assignments and experiments
Duration of course normally decided by the engineering student	College of engineering has calendars and set durations for courses

E-learning for engineering learners, in all its glory, is the type of instruction that supplements conventional face-to-face teaching and learning activities, and provides a more efficient experience to the student. E-learning represents learning through the application of electronic media and devices, involving the transfer of content via Internet/intranet/audio or video tape, satellite broadcast, interactive TV, or CD-ROM (Sommer, Bach, Richert, &Jeschke, 2014).

Apparently, e-learning for engineers is the integration of technology to promote active learning in the educational process. Basically, it is about placing the student at the center of his/her own learning by providing them with adequate materials and tools. The engineering e-learners are free to direct themselves and take responsibility of their own learning in a way that matches their personal needs. E-learners are able to acquire and build information and skills in a setting that has been adjusted to meet their expectations. Moreover, "the use of the Web as an educational delivery medium (e-learning) provides engineering students with the opportunity to develop an additional set of communication, technical, teamwork, and interpersonal skills that mirror the business environment in which they will work" (Noroozi, Valizadeh, & Sorial, 2010, p. 8).

Nonetheless, engineering learners, as opposed to the idea that they can be viewed as "digital natives", do not all have the same positive reaction to the e-learning experience; certain students prefer on-campus classes. Engineering learners may respond separately to the e-learning setting, based on their skill and perception. Sheard and Lynch's (2003, as cited in Inoue, 2007) declare:

> Study on learner diversity has indicated that different students experience and react to an online environment in different ways, depending on their previous experience, and no one format is going to meet the needs of all students. Therefore, constant challenges for online learning are student's familiarity with the learning environment and their skills and confidence with the Internet and IT. (p.125)

In fact, engineering education needs to address today's challenges. It is clear that every learner has various learning styles and paces; therefore, the learning content should be developed to meet the needs of different audiences, so that learners can choose adequate activities according to their privileged learning styles (Ally & Samaka, 2016). The following table presents the characteristics of old and new paradigms of engineering education:

Table 6. *Characteristics of Old and New Paradigms of Engineering Higher Education.*
Adopted from (Singh, 2019, p.29)

Engineering Education (Characteristics)	Old Paradigms	New Paradigms
The Curriculum	Focused on scientific and technical courses as the core of an engineering education	Not only focused on scientific and technical courses but include new curriculum that must reflect a broad range of concerns.
The Ability and Skills	Technical knowledge and skills	-Technical knowledge and skills -Communication skills -Teamwork/teambuilding
Pedagogical Style	Classroom based pedagogy-lecture-dominated system	Active learning approaches that engage problem-solving skills and team building.
Lifelong Learning	Less awareness on lifelong learning	Aware on the importance of lifelong learning and concerns more on the knowledge of how to learn.
New Technologies	From microscopic level of info-bio-nano	To the macroscopic level of global systems
A Broader Concern	Focus primarily on educating students for the engineering profession	Educating not simply profesional engineers but a new breed of graduates with an engineering-based, liberal education.

1.3.1. Problem-Based Learning in Engineering Education: A New Approach

Over the last few years, research has been carried out in many countries to identify the technical and personal skills central to today's engineers. This research has revealed some general concerns. Recent engineering graduates must possess team building skills as well as good communication competencies, but they lack such skills. They must possess a wider vision of the challenges that continue to face their occupation, but yet they don't. Eventually, young graduate engineers possess in general a basic theoretical knowledge, but they have difficulty in applying it to problems of practice. Accordingly, this emphasizes that teaching engineering education should involve strategies and approaches that offer many chances to learners so as to promote the improvement of such skills (Wang, Li, Fu, Liu, & Jiang, 2016). In doing so, the following criteria should be taken into consideration (Mills & Treagusr, 2003):

- Engineering educational programs are more concerned with science and technical knowledge without giving enough use of these issues or linking them to engineering practices. Curriculum is content driven.

- Existing programs do not ensure enough engineering design practices and processes to learners.
- Today's graduates still lack adequate communication skills and the ability to work in groups and collaborate with others. Therefore, new approaches to teaching engineering education should be incorporated to help students improve such important skills.
- The current instructional strategies used in engineering education are old-fashioned and have to be more learner-centered.

The solutions mainly suggested to address most of these problems require radical redesign of the education program in engineering education. Therefore, Problem-based Learning (PBL) has been introduced to several engineering programs to help learners develop the necessary skills and competences. According to Graff et al., (2007) PBL is "an instructional method where students 'learn to learn', working cooperatively in groups to seek solutions to real world problems" (p.57). It is a new student-driven instructional approach that prompts learners to think critically and analytically. Within this context, learners acquire skills in "self-directed learning, critical thinking, self-evaluation, interpersonal communication" and the skills to collect, obtain, and utilize knowledge (Bentley, 2004). This strategy focuses on a concrete problem-solving process that a small group of students takes part in so as to find a solution. Students thus, become active participants in the learning process; "students formulate and pursue their own learning objectives by searching a situation, developing appropriate questions, and producing their own solution to a problem" (Maxwell, Mergendoller, & Bellisimo, 2005, as cited in Wurdinger, 2012, p.45). PBL identifies the students' existing knowledge and promotes the students to recognize their own learning processes. Conventional instruction methods that aim to overburden learners with content do not help them in acquiring the skills required in real situations. Without a thorough comprehension of the problem and practice of a specific case, learners will memorize information for just a short period of time, and then information fades quickly; therefore the students are left with an empty or impractical education. Storing information does not help students in addressing the complex issues encountered in engineering practice. Learners have to know how to connect previously learned ideas and notions with new information so as to make the right choices needed for addressing a set of problems they may face in real situations (Bentley, 2004).

In Problem-Based Learning, instructors are no longer at the center of the learning experience. Their role has changed from one of knowledge providers to facilitators who guide students in the process of learning. The instructor is in charge of setting out the objectives of the meetings by determining what is to be fulfilled and how the process operates. According to Hadgraft (1997), the instructor's roles in PBL is of "providing students with adequate initial learning resources; providing a structured learning experience for those students who need it…keeping students jobs on-track; helping to solve technical problems if necessary, and assessing students work" (as cited in Heywood 2005, p. 238). The implementation of PBL in engineering programs requires a shift from teacher-centered to learner-centered instruction and therefore necessitates a fundamental shift in the way learners acquire knowledge and the role that faculty members play in simplifying learning. Krishnan (2012) claims:

> Lifelong competencies engendered by problem-based approaches to learning include the ability to adapt and participate in change, deal with problems and make reasoned decisions in unfamiliar situations, reason critically and creatively, adopt a more universal or holistic approach, practice empathy, and appreciate others' perspectives, collaborate productively in groups or teams, identify personal strengths and weaknesses, undertake appropriate remediation such as self-directed learning and meta-cognitive reflection. (p.26)

Unlike the conventional approach to designing engineering curricula (see figure 7) that merely depends on a single discipline and in which the teacher is the only source of knowledge, problem-based learning (see figure 8) is an innovative teaching approach that consists of a lecture unit succeeded by a PBL unit, focusing on applying information learned in the course to a real problem situation (Li, 2013).

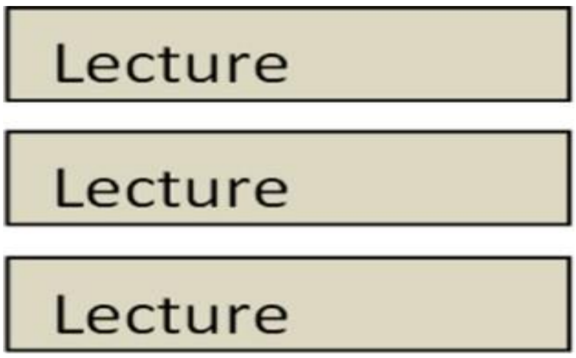


Figure 7. *"Conventional Curriculum Model".* Adopted from (Li, 2013, p. 27)

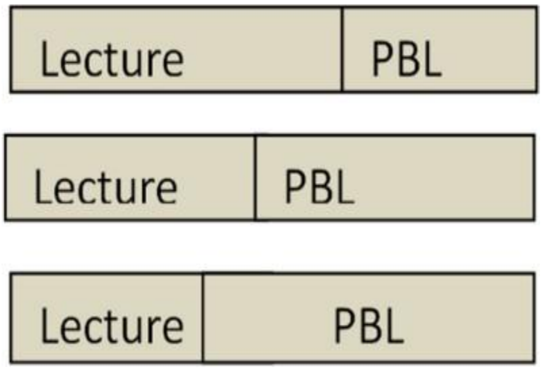


Figure 8. *“PBL Curriculum Model”.* Adopted from (Li, 2013, p. 28)

1.3.2. Laboratory Instruction in Engineering Education

The primary purpose of engineering education is to prepare learners for engineering practices, and especially to handle the great sources of power in nature. Therefore, from the earliest stages of engineering education, pedagogical laboratories have been a fundamental component of its programs. In fact, engineering education relies heavily on laboratories since it is a practical discipline (Handur, Naragund, & Kalwad, 2014). Apparently, “All engineering programs must demonstrate that their graduates have the ability to design and conduct experiments, as well as to analyze and interpret data, design a system, component, or process to meet desired needs; and use the techniques, skills, and modern engineering tools necessary for engineering practice" (ABET engineering criteria, as cited in Anis, 2011, p.45). According to Alam, Hadgraft & Subic (2014), the primary goals of a laboratory practice are, “the cognitive learning (integration of theory with practice), inquisitive learning (hypothesis development, design of experiment and methodology, and evaluation of data, results and findings), vocational learning (awareness of current practice and inculcation of professional ethics), and communication learning (communication, presentation, report writing and team work skills)” (p. 290).

Hands-on laboratories increase a learner’s ability to effectively link theoretical understanding with concrete practical activity. The conventional hands-on laboratory practices require physical existence of faculty members, physical facilities and materials that grant learners an approximation of the real world experiences. By participating in laboratory experiments and using the material, the learners are engaged in observing dynamic phenomena, testing hypotheses, and learning from their mistakes (Razali & Trevelyan, 2012). Presently, the educational focus in engineering education has changed towards theoretical instruction employing ICT tools. Technology advances have permitted the creation of new online laboratories: web-based virtual labs and remote labs. The virtual labs or sometimes called web-based simulators are characterized by the implementation of simulated experiments and models to mimic the traditional physical lab environment (Kehind, Chen, Ayodele, & Akinwale, 2011). The function of virtual laboratories is to practice experiments that would involve sophisticated and pricey equipment. Moreover, learners have the right to repeat an experiment several times, providing them with the chance to understand how modified variables and criteria affect the result. Besides, one of the most significant traits of virtual labs is allowing learners to learn from mistakes without damaging the physical material. Remote labs permit remote access to experiments without time and place restrictions. In remote laboratories, learners use the Internet to physically carry out real experiments. Learners get concrete findings utilizing concrete materials and reach actual outcomes, the same as if they were in the real lab environment (Alam, Hadgraft, & Subic, 2014). The following table presents certain characteristics of several laboratory practices:

Table 7. *Characteristics of Several Laboratory Practices.* Adopted from Alam, Hadgraft, & Subic (2014, p. 292).

Feature	**Hands on Laboratory**		**Simulated Laboratory**		**Remote Controlled Laboratory**	
	Advantages	**Disadvantages**	**Advantages**	**Disadvantages**	**Advantages**	**Disadvantages**
Accessibility	Realistic data	Space constraint	No time and space restriction	No interaction with real equipment	No time and space restriction	Virtual presence in the labs
Infrastrutcture	Offer students a sense of reality	Vulnerable to damage and misuse	Good for conceptual understandi ng	Need software update	Offer students to conduct repeat lab	Needs software updating and high speed Internet
Pedagogical	Offer students to collaborate	Supervision is required	Enhanceme nt through animation and virtual reality	No sense of real experiment	Feeling close to real data	Need enhancing both social and design data
Economical	Expensive capital and maintenance cost		Relatively low cost and no maintenance cost		Cost not clear yet but believed to be in between hands on & virtual labs	

1.3.3. E-learning for Engineering Education: A New Pedagogy is Emerging

The implementation of e-learning technology offers a chance for surmounting most of the challenges that may appear in traditional engineering instruction (Moeller & Sitzmann, 2012), including:

- Recognizing how to address problems founded on a complex theoretical framework by developing computer simulation and modeling methods.
- Taking into consideration the needs and expectations of various user groups with diverse skill levels, abilities, and learning paces.
- Preventing traditional constraints linked to place, time, and space, as well as granting educational access and equity in educational opportunities.
- Offering flexible educational programs that promote multidimensional learning process.
- Addressing the learning requirements of diverse target groups.

In addition to this, comparing conventional and online instruction, e-learning for engineering education provides special educational opportunities to increase students' performances (Noroozi, 2010) including:

- E-learning is essential for engineers since it grants rapid and convenient update of instructional materials- a significant role for this active occupation. This, linked to the quick transfer of content, allows online materials to be the primary option for several engineering instructors.
- E-learning offers a convenient method to address the technical issues through the realization of complex physics simulations. Utilizing interactive computer modeling techniques, graphics and visual representations generates enhanced efficiency of the engineering education.
- Visual representations are of vital significance for engineers and online instruction offers inexpensive and efficient tools for disseminating great amount of pictures (through the Internet). Moreover, online instruction can ensure a method of visual manipulation, which has no equivalent in other ways of publications.
- "The search function" provided by several online course materials grants another benefit. This is too crucial for engineers.

- Eventually, since a lot of engineering learners worldwide can access the instructional resources through the orientation of most famous experts has no alternative in the other instructional practices and means of communication.

E-learning system for engineering education is “an educational method that is able to provide opportunities for the needed people, at the right place, with the right contents, and the right time” (Lee & Lee, 2008, as cited in Moeller & Vakilzadian, 2012, p.32). E-learning for engineering education provides particular educational chances to improve student performance: in today’s online education, there exists obvious advantages that can be emanated from e-learning:

- E-learning is interactive; the computer software programs allow the engineering learner to interact not just with the instructor, but with their classmates too. It enhances and complements the campus-based learning through the implementation of the Web.
- E-learning supports “interactive and exploratory modes of inquiry”
- E-learning enhances and encourages “team-oriented collaborations”
- Students’ grades and content are available online and learners can visit the websites from any place in the globe.
- It is totally opposite from distance education in which an engineering learner is provided with instructional materials and expected to study and solve problems alone until exam period.
- E-learning has the power to provide information continually to students by offering identical notions and knowledge engineering techniques- dissimilar to traditional learning environment, where various teachers may not use the same educational program or instruct diverse elements within the curriculum.

The following figure summarizes most of the e-learning benefits to instructors and learners in engineering education:

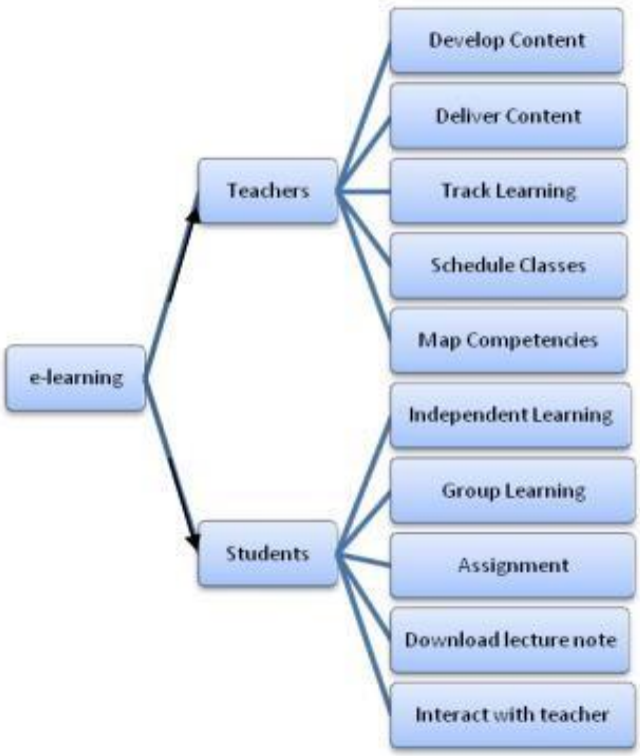


Figure 9. *E-Learning Benefits to Instructors and Learners.* Adopted from (Singh, 2005; Michau, Gentil, & Barrault, 2001)

The implementation of Information Technology (IT) has become a basic element in multiple course environments. IT uses are not restricted to the classroom; they are substituting certain class meetings with virtual learning classrooms or wholly substituting traditional education by online instruction (Zhao et al, 2012). While more HEIs embrace online education, a number of concerns develop:

- Institutions must ensure an appropriate framework and adequate technical assistance to promote the online activities.
- Teachers and learners must have well developed information technology literacy skills to effectively utilize online tools.
- Educators must restructure their courses and adapt their teaching practices to integrate e-learning efficiently into the instructional experience.

1.3.4. Engineering Education and Assessment Practices

Assessment is a form of defense for teachers and educators to demonstrate the outcomes of their rigorous work, and to show how much their students are increasingly learning.

According to Salvia, Ysseldyke & Witmer (2009), "assessment is a critical practice engaged in for the purpose of matching instruction to the level of students' skills, monitoring student progress, modifying instruction, and working hard to enhance student competence (p. 17). The development of engineering education relies heavily on assessment. Adequate assessments can equip teachers with information they can use to plan and modify sequences of instruction. Inappropriate and poor assessments may lead teachers to follow inefficient teaching methods. In an engineering education environment, assessment is the key element in determining the students' achievement and monitoring their progress. According to Felder, Sheppard, & Smith (2011) "research, by its nature, requires effective assessment. The infusion of accepted principles and practices of educational assessment are having a significant impact on the development of engineering curricula and the evaluation in terms of student performance" (as cited in Subheesh & Sethy, 2018, p. 4).

Engineering learners involve some skills that would not be assessed efficiently by conventional assessment methods that depend on the reproduction of stored information. Moreover, assessment is designed and performed without establishing the educational goals. One method and one assessment practice are used throughout a course of study. Assessment is considered as just a procedure in which instructors often provide quantitative feedback and rarely qualitative feedback. This usually results in inefficient and ineffective learning experience. Contrary to conventional assessment methods, 'authentic' assessment methods have been set up and are thoroughly corresponded to educational goals. These draw attention to the improvement of learners' academic achievement, competence, and ability. The planning and execution of such assessment practices are seen as professional missions in which majority of the engineering instructors lack proficiency (Rashad et al., 2008).

In higher education, evaluation is fundamentally about making judgments about the worth of something. It relies on the use of quantitative proof/figure (numerical value), and does not involve the qualitative feedback element. Therefore, evaluation is merely quantitative by definition. Unlike evaluation, feedback is an indispensable element of the assessment. The concept of assessment inevitably involves qualitative feedback. Accordingly, assessment can be viewed as qualitative. The feedback involved in assessment is practiced to enhance learners' learning outcomes as well as instructors' teaching experiences (Rashad et al., 2008).

1.3.4.1. Types of Classroom Assessments

Formative assessment and summative assessment are both viewed as “types” of assessment. Formative assessment is identified as an assignment or activity that offers feedback for learners about their academic progress (Bell & Cowie, 2006). It does not involve a quantitative grade; rather, it includes a qualitative feedback element. Formative assessment attempts to assist learners improve self-consciousness and self-regulation skills, and reinforce their learning practices in connection to the desired learning outcomes of the educational program. In a formative assessment, learners become involved in taking an active role in assessing their own learning and realize what has been improved, ignored or missed. The practical side of engineering education, by means of hands-on sessions in laboratories and practical project assignments, is crucial and can be regarded as supplementing the theoretical classroom knowledge. Laboratory experimentation and field investigations are excellent ways to assess students’ knowledge. The instructor can also assess the groups’ learning through assigning group projects; however, it should be mentioned that assigning learners with a group project does not ensure that the learning will occur in a group. The group project may be partitioned into sub teams so that each team will work on a specific task. This will make the mission of assessing the group’s learning complicated. In such a situation, the instructor may propose peer assessment so that the learners check and examine each other’s outcomes. Thus, this can strengthen the learning efficiency because all learners will be engaged in the learning process (Harlen, 2007).

Summative assessment refers to activities and assignments that evaluate students’ learning and academic achievement. It is conducted periodically and provides students with grades on their performances in the course. Summative assessment grades are utilized to rank students from high to low achievers (Oermann & Gaberson, 2014). On the other hand, assessing students and particularly through formative assessment is time consuming, it involves a lot of work from instructors to monitor each student’s performance particularly when teaching large classes; consequently, instructions do not consider all of the measures involved in formative assessments (Barron et al., 1998, as cited in Luminou & Smith, 2012).

1.3.4.2. Towards E-Assessment Models

The rapid expansion of information and computer technologies has granted instructors the chance to appropriately provide individual feedback to learners “e-assessments” by approaching the problems of the number of learners and instructors' time constraints. Significantly, Internet technologies, e-learning platforms, and online learning environments like MOOC, Moodle, and others enable learners to fulfill their requirements and to employ it in a way commensurate with their learning styles (Luminou & Smith, 2012). Such systems permit instructors to plan e-assessments (once) and utilize them countless times, whereas additional online tools like wikis, chat rooms, e-mails, etc. could improve the online interaction and dialogue between teachers and students. Due to the higher flexibility, cost and time efficiency, e-assessments are gradually implemented into several colleges' educational programs around the globe. E-assessments enable instructors to provide learners with feedbackfaster and they are also easier in contrast to written examinations. By determining learners' common errors on particular issues and their misunderstandings on particular cognitive matters, instructors can readily adjust their instruction methods to satisfy learners' requirements.Furthermore, many scholars have examined how e-assessment should be planned so as to offerlearners the chance to carry out more autonomous self-assessment, acquire feedback, and identify mistakes (Oermann & Gaberson, 2014).

The quick feedback provides learners the possibility to progress by learning from their mistakes and reviewing their answers without relying on instructors. A set of various types of questions including short answer, true and false, multiple-choice and matching exercises and so on can be useful means for learning (Luminou & Smith, 2012). Apparently, "assessment must be a continuous process that facilitates 'online learning' instructional decision making inthe classroom" (Gitomer and Duschl, 1995, as cited in Bell & Cowie, 2006, p. 24). Eventually, educational policy should consider the significance of assessment design to improve learners' learning. The following criteria should be taken into account when designing assessment tests in engineering courses:

• They are linked to the instructional method(s) adopted by the instructor.

• They are adequately linked to the desired learning results and assessment requirements of the course.

• They are permanently evaluated by the learners and instructors to enhance their quality and effect on learning to guarantee that they are effective, fair, adaptable and viable.

• Their content and instructions are precise, unambiguous, and clear.

Section Four: Theoretical Framework for E-Learning Usage in Teaching and Learning

1.4. Learning Theories in the Context of Implementing E-Learning in the 21st Century Teaching and Learning

It is necessary to define the various learning theories before examining the utilization of e-learning technology. "To investigate the use of e-learning technologies, it is important to understand the concept of learning through theories. It is also important to understand the implications of different learning theories for the development of e-learning" (Bejjar & Boujelbene, 2013, p. 2). The primary theory-based approaches are Behaviorism, Cognitivism, Constructivism, and Connectivism (Harasim, 2017). The current research embraces Constructivist and Connectivist learning principles in regard to examining the e-activities in the teaching and learning processes using educational technologies in HEIs. E-learning "is still struggling to gain acceptance and respect and is sometimes ignored by the conventional university system" (Harry, 2002, p. 7). E-learning is not taken for granted as an approach for high-quality delivery, and until now there exist no reliable e-learning approach likely to be adopted in higher education departments with encouraging outcomes. According to Pelet (2013), "conventional learning theory and e-learning theory are best conceived as overlapping cycles that facilitate and enhance the learning process" (p.331). However, the overall level of e-learning integration depends heavily on the experiences and traditions of an institution to cope with the overall innovations and objectives (Sangra, Guardia, & Fernandez-Michels, 2009).

Scepanovic, Guerra, & Lubcke (2015) claim that behaviorism, cognitivism, and constructivism represent the main learning theories that are absolutely not new in the pedagogical setting; they emerged in the 20th century before the development of today's technology. Over the last decade, information technologies have revolutionized the way we live, work and do business. Nevertheless, technology-based learning theories still encounter certain deficiencies in terms of efficiency and practicality.

The present section tackles the theoretical framework underpinning the current study; moreover, it depicts changes in the field, new horizons and the pedagogical potential of e-learning practices in Morocco and other countries for teaching engineering education. The framework for the current study is basically linked to the context of teaching and learning engineering education in Moroccan universities via the implementation of e-learning; the framework can be examined and then evaluated. Balamuralithara & Woods (2009) assert that "the e-learning framework can be developed based on the special requirements of engineers using approaches such as simulation, animation, and remote access laboratory work" (as cited in Moeller & Sitzmann, 2012, p.198). Nonetheless, e-learning cannot be used as the main teaching method for engineering education in tertiary education except if it is coupled with conventional teaching methods to greatly improve the quality of the teaching activities, and thus accomplishing the aim of high quality instruction (Wang, 2014).

The instructional content in e-learning environments should be resulted from theoretical approaches of engineering education that best fit the desired goals, students' own learning styles, and based on the instructor's functions in spreading the learning content and offering the adequate feedback. However, most of these traits are neglected when referring to a practical framework founded on valid theories in engineering education. The implementation of e-learning requires diverse activities which are designed by instructional principles and applied theoretical background. Airhihenbua & Obregon (2002) claim that "frameworks are designed to guide the implementation and evaluation of programs along certain processes that are believed to yield an expected outcome" (as cited in Rukhsana, 2012, p. 150). The following figure introduces the conceptual outline of the research framework:

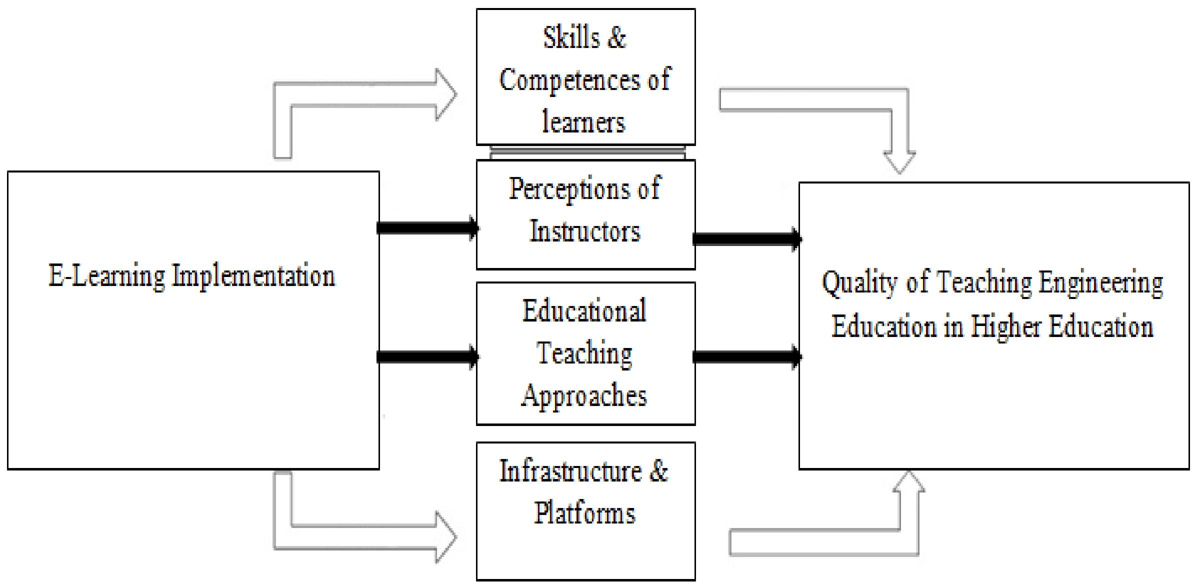


Figure 10. *General Conceptual Framework for the Study*

1.4.1. Theories of Computer-Assisted Instruction

With the passage of time, theories basically alter to meet new goals and new challenging educational standards. Kelly (2008) states:

> Studying theories of learning and change should better prepare us for practicing learning and change…Theories allow us to consider and examine the world in ways that are otherwise very difficult. By abstracting away much detail and considering a few key factors, they allow us to look at the issue in hand in a new and potentially revealing way. This provides a grounding for conducting learning and change in practice. (p.12)

Computer Assisted Instruction (CAI) also known as Computer-aided Learning (CAL) is a varied and rapid growing spectrum of computer technologies that enhances the learning outcomes (Singh, 2019). Many investigations examining the utilization of CAI in engineering education have indicated that it would be an efficient tool for improving learning and teaching. The implementation of a preliminary computing class for engineers results in a more efficient learner learning and that the learners acquire a profound knowledge utilizing a multimedia textbook, than a conventional printed form (2019).

In fact, learning is a complex process that has produced various philosophies and learning theories of how it is successfully achieved. The common theories that are broadly applied in the technological education setting as stated before are behaviorism, cognitivism, constructivism, and connectivism. According to Arshavskiy (2013), each learning theory has its own advantages and limitations within the context and conditions of its use; therefore the choice of the theory that fits particular educational setting relies on many aspects of learning including educational objectives, students, and circumstances.

1.4.1.1. Behaviorism

The behavioral approach to learning was developed in the early 20th century and has been a leading psychological approach in the planning of education programs and educational technology. Behaviorist learning theory considers all that is observable and measurable in behavior rather than the inner functioning of the mind. Behaviorists asserted that only observable behavior deserves consideration. The learner is described as being reactive to circumstances in the environment rather than taking an active role in exploring the environment (Harasim, 2017).

In the field of computer-assisted instruction, behaviorist strategies have impacted a great number of the most prominent educational technologies, from basic computer assisted instruction (CAI) to modern page-turners and drill-and-practice games. The precise principles for the application of behaviorist theory to instructional systems design are presented in the table below (Singh, 2019):

Table 8. *Precise Principles (Behaviorism) to Instructional Design* (Singh, 2019. p. 84)

Learning Theory	Principles to instructional design (ID)	Possible ID applications
Behaviourism	An emphasis on producing observable and measurable outcomes in students	behavioural objectives, task analysis, criterion-referenced assessment
	Pre-assessment of students to determine where instruction should begin	learner analysis
	Emphasis on mastering early steps before progressing to more complex levels of performance	sequencing of instructional presentation, mastery learning
	Use of reinforcement to impact performance	tangible rewards, informative feedback
	Use of cues, shaping and practice to ensure a strong stimulus-response association	simple to complex sequencing of practice, use of prompts

1.4.1.2. Cognitivism

Cognitivist theory substituted behaviorism in the mid-twentieth century since many theorists were not pleased with the mechanism perspective of behaviorism and claimed that learning would be totally ineffective if learners had to depend completely on the packaging for learning (Chomskey, 1972, as cited in Pelet, 2014). Cognitivists believe that learners profit from learning when they can link new knowledge to previously acquired knowledge. Therefore, learning does not focus on what learners do but rather on what they know and how they arrive at achieving it (Jonassen, 1999, as cited in Singh, 2019). The learner is regarded as fully involved in the learning process that requires cognitive activities, "cognition is the process of acquisition, storage, processing and use of knowledge to solve problems" (Maltin, 2002, as cited in Pelet, 2014).

Cognitivism has impacted the educational technology particularly for the planning and creation of the Intelligent Tutoring System (ITS). Intelligent tutoring system is a computer based educational system that attempts to ensure personalized and prompt learning or feedback to learners without teacher interference. ITS adjusts to an individual learner's performance systematically by relying on the information included in its database in place of just "the predetermined questions, answers, and predefined pathways that made up behaviorist's CAI technologies" (Peters, 2014, as cited in Singh, 2019). The main principles for the use of cognitivist theory to instructional design are depicted in table 9 below:

Table 9. *Main Principles (Cognitivism) to Instructional Design.* Source: Singh (2019, p. 86)

Learning Theory	Principles to instructional design (ID)	Possible ID applications
Cognitivism	Emphasis on the active involvement of the learner in the learning process	learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques)
	Use of hierarchical analyses to identify and illustrate prerequisite relationships	cognitive task analysis procedures
	Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing	use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.
	Creation of learning environments that allow and encourage students to make connections with previously learned material	recall of prerequisite skill; use of relevant examples, analogies

1.4.1.3 Constructivism

Constructivist theory is a learning theory that holds that learning is an active process of construction of its views on the universe, relying on learners' previous knowledge (Bruner, 1966, as cited in Bejjar & Beoujelbene, 2013). In the constructivist approach, learning is not only about passively storing information that has been delivered by a source of knowledge "teacher", rather as an active and self-regulated process that builds on learner's prior knowledge, where learners are active participants (Duschesne & McMaugh, 2018). Jonassen (1994, as cited in Freisen, 2009) adds:

> Succinctly, constructivism avers that learners construct their own reality or at least interpret it based on their perceptions of experiences, so an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events.… What someone knows is grounded in perception of physical and

social experiences which are comprehended by the mind. What the mind produces are mental models that represent what the knower has perceived. (p. 82)

Learners in this regard are seen as "little scientists" "little logicians" or "little mathematicians" who construct knowledge via the application of techniques that enhance the practicality and functionality of this knowledge, progressively making it more particularized and adept (Freisen, 2009). The constructivist learning theory was adopted to create an integrative educational setting that enhances the traditional classroom instruction by the e-learning in which the learner is an active participant in constructing knowledge (Harpe & Pterson, 2009). The main principles for the use of constructivist theory to instructional design are depicted in table 10 below:

Table 10. *Main Principles (Constructivism) to Instructional Design.* Source: Singh (2019, p. 87)

Learning Theory	Principles to instructional design (ID)	Possible ID applications
Constructivism	An emphasis on the identification of the context in which the skills will be learned and subsequently applied	anchoring learning in meaningful contexts
	An emphasis on learner control and the capability of the learner to manipulate information	actively using what is learned
	The need for information to be presented in a variety of different way	revisiting content at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives
	Supporting the use of problem solving skills that allow leaners to go "beyond the information given"	developing pattern-recognition skills, presenting alternative ways of representing problems
	Assessment focused on transfer of knowledge and skills	presenting new problems and situations that differ from the conditions of the initial instruction

1.4.1.4. Connectivism: A New Learning Theory

The learning theory of connectivism was developed to overcome the limitations of behaviorism, cognitivism, and constructivism. It took into account the manner in which society has been altered as a consequence of the modern technologies of the information era (Garcia, Brown & Elbeltagi, 2012, as cited in Singh, 2019). "Knowing and learning are today defined by connections…Connectivism is a theory describing how learning happens in a digital age. Connectivism is the assertion that learning is primarily a network forming process" (Siemens, 2006 as cited in Pettenati & Cigognini, 2009, p. 113). Actually, learning occurs when learners work together in a learning setting in which knowledge is put into practice through debating, exchanging, and reasoning, this principle is extremely supported by online learning; the e-learning platforms in which instructors and learners, learners and learners are exchanging information, producing information, communicating and learning (Pettenati & Cigognini, 2009).

In connectivism, the notion of knowledge is very essential since it is rejuvenated from time to time, “the continual expansion of knowledge as new and novel connection open new interpretations and understandings to create new knowledge” (Starkey, 2012, para 3); therefore, it is necessary to make a distinction between significant knowledge and insignificant knowledge (Siemens, 2004 as cited in Starkey, 2012). Correspondingly, the basic principles of connectivism do not concentrate on computer networks, and instead focus on connecting, by certain undefined “mechanisms”, “nodes” which are meant to comprise “humans, devices, or, more generally, any information sources” (Minimair, 2017). Connectivism is characterized by several principles (Siemens, 2006, as cited in Pettenati & Cigognini, 2009):

- Learning and knowledge involve variety of views, interaction, and communication to allow selection of appropriate practices.
- Knowledge lies in networks.
- Knowledge may rest in non-human appliances (e.g., databases).
- Learning involves promoting and sustaining connections.
- Ability to learn more is more important than what is presently learned.
- Knowing and learning are continuing processes.
- Knowledge is an enabler, a part of the learning process.
- Learning involves a critical lens.
- Learners’ decisions are impacted by the information atmosphere.

Accordingly, connectivism strives to produce a theory that takes into account how individuals, organizations, and technology can cooperatively produce knowledge (Starkey, 2012). In fact, this theory is perfect for blending e-learning with traditional instructional methods where learners are interacting easily and learning effectively in a veritable setting, the feedback they get is a sort of guidance from their educators, thus they are guided both inside and outside the classroom, the learning process is not aimless.

1.4.2. Digital Learning Acceptance and Challenges

Digital Learning has been a total paradigm shift in American universities as well as in many education institutions all over the world. It has brought forth a “new generation of learners whose skills and expectations derive from going up on the net” (Raschke, 2002, as cited in Herrington, Reeves, & Oliver, 2009, para. 1). This progress has been noted in European countries too through the development and adoption of such systems in their higher educational curricula. The reason behind Europe’s adoption of an e-learning system is the vast growth in student numbers annually alongside the decreasing number of teaching staff. Likewise, the struggle was to incorporate these modern ways of teaching as a strategy to maintain high quality education as a key component. Thus, adopting digital learning within HEIs has become ubiquitous and integral part of many European countries. Thalhammer (2014) states:

> Information and communication technologies (ICTs) were placed at the core of programs and initiatives of the ‘Lisbon Agenda’ of the European Commission. The eEurope Active Plan, one of the subsequent initiatives, encompassed a series of short-term plans seeking to integrate ICT into every aspect of economic, social and political life in the European Union (EU). One proposal in this plan was the ‘e-Learning Initiative’, a political declaration of objectives aimed at incorporating ICTs in education. Consequently, several programs and initiatives were funded by the EU to improve integration, infrastructure, equipment, and basic education in ICT. (p. 47)

Nearly all advanced nations possess the basic infrastructure and the appropriate facilities to incorporate electronic learning into the learning environment, and to adapt it to suit their educational purposes (Olaniran, 2009). Among these services is the evolution of mobile high technology tools namely smartphones, tablets and computers, which brought forth a new generation of learners characterized as ‘digital natives’ who help in raising the standard of teaching and the quality of learning (Mengel, Kuszpa, & De Witt, 2009). Kim (2006) clarifies:

> Governments have recognized web-based learning as a key tool for increasing national competitiveness. They have sanctioned online universities in order to educate citizens who have difficulty attending traditional universities for various reasons, including cost, schedule conflict with employment, and also started considering web-based learning as an element in lifetime continued education programs for their citizens. (p. 1)

On the other hand, most of the developing nations encounter several challenges in their attempts to grant essential needs such as education. Gauci & Nwuke (2001) state that "universities in developing countries are lagging behind in terms of benefiting from the immense opportunities that Information and Communication Technologies (ICTs) have brought to their counterparts in developed countries" (as cited in Naidoo, 2016, p. 183). Adopting web-based learning within colleges in developing countries at a similar pace as developed countries has not been an easy task since least developed nations have numerous complicated political, social, and economic issues of higher priority than of higher education (Naidoo, 2016). According to Garisson & Anderson (2003), e-learning has invaded South African universities since the 1990s. Ravjee (2007) adds "in South Africa clear policy supports for the role of ICTs in enhancing education and in contributing towards broad post-apartheid reconstruction is evident in the 1997 White Paper on Higher Education, the 2001 National Plan for Higher Education, the 2003 Draft White Paper on e-Education 2003, and the 2004 ICT Charter" (as cited in Naidoo, 2016, p. 183).

A research carried out by Chitanana, Makaza, & Madzima (2008) on the adoption of web-based learning by Zimbabwean universities showed that these colleges are willing to try new approaches in their teaching through the integration of online learning, though the research findings demonstrate that this is being realized at a slow pace (Naidoo, 2016). Moreover, Kenya is distinguished as a country with prosperous technology infrastructure and high Internet penetration, which make its universities in support of online education (Sivaraj, 2019). "Kenyan universities were allocated an average of 0.5% of their total recurrent expenditures on Internet bandwidth to support implementation of e-learning. As a result, the universities in 2013 achieved Internet bandwidth increase to 4.0 Mb/s per 1,000 students compared to only 0.431 Mb/s per 1,000 students in 2008" (Naidoo, 2016, p. 183). This positive experience in Kenya although not perfect has been a key factor for new possibility for education in the country.

Besides, the adoption of ICTs in an Arab country such as Libya is still encountering a number of challenges and problems. Rhema & Miliszewska (2010) report "while some Libyan universities…have the basic ICT infrastructure…they still use the traditional model of education; this model is based on face-to-face interactions in and outside of classroom between students and teachers, and learning activities that are only available on campus" (p. 417). Libya's effort to integrate e-learning into its education system is depicted in several initiatives such as the Libyan National ICT Policy for Education that aims to provide all HEIs with technological infrastructure. Nonetheless, the implementation of this policy as claimed by

(Rhema & Miliszewska, 2010, p. 429) still lag behind due to the many challenges they face including:

- Educators and students' diverse cultural and linguistic background.
- Students and educators' awareness and attitudes towards e-learning.
- Unsophisticated technology and the high cost of instructional technologies.
- The severe shortage of local expertise in the field of e-learning technology.
- The shortage of instructional management mechanisms to promote e-learning systems.

During the last three decades, ICT-related initiatives have become the prime focus of the Hashemite Kingdom of Jordan. "The turning of the 21st century witnessed concrete steps taken to incorporate ICT throughout the Jordanian education system" (Abuhmaid, 2010, p. 37). In fact, Jordan is classified among the first countries in the Middle East in the information technology zone. Jordan's initial e-learning initiative was launched in 2002 and aimed at attaining national e-learning via the creation of "national knowledge networks" in which the adoption of ICT was a basis for the move to the e-learning system. This system relies on the development of autonomous learning and critical thinking instead of the conventional mode of teaching that mainly relies on lectures and textbooks (Abuhmaid, 2010). Nevertheless, the general advancement in the utilization of e-learning programs in the tertiary education institutions in Jordan is still beyond expectations. Accordingly, the reviewed literature reveals that one of the main challenges affecting the integration of e-learning in Jordanian universities is the teachers' hesitancy to promote classroom technology use (Al-Shboul & Alsmadi, 2010).

1.4.3. The Development and Current State of E-learning in Morocco

The Moroccan society has witnessed fundamental changes in various fields of activity. Actually, Morocco has begun to make from ICT a key factor in the advancement of the knowledge economy. The Moroccan educational system keeps placing several attempts to support this sector via active participations in multiple innovation processes and initiatives. The first stage of e-learning in Morocco was quite limited and represented by scattered attempts to adopt ICT as a means of communication and a ground for knowledge sharing (Ajhoun & Daoudi, 2018). Nonetheless, e-learning started to develop with the creation of international collaborations between higher education institutions. One of the collaborative initiatives Morocco took advantage of was PRICAM (International Strengthening Program with a

Training Mandate). PRICAM was launched in 1997 and joined together colleges in Morocco and Canada. The initiative intended to enhance the quality of teaching in the institutions of sciences and technologies and to develop new approaches in teaching. Moreover, with the purpose of integrating itself into the global information and knowledge society, Morocco has launched diverse national initiatives for the adoption of ICT in its education systems (Ait Hajji, 2018):

- The MARWAN Project (Moroccan Academic and Research Wide Area Network) was launched in 1997 and activated in 2002. It aimed at guaranteeing low-cost access to the Internet for Moroccan higher education institutions in order to promote the development of ICTs in its system.
- CATT (Computer Assisted Teaching Training): was put into practice in 1999 supported by the USAID (American Agency for International Development). Its main purpose was to train teachers and instructors.
- The GENIE program (Generalization of Information and Communication Technologies in Teaching in Morocco) launched in 2006. The program is based on three axes: ICT equipment, teachers' and school administrators' training and curriculum development.
- CVM (Moroccan Virtual Campus) launched in 2002. Its principle missions are to create collaborations between the different e-learning initiatives within Moroccan colleges, allow learners to select their study place and time, promote information access, and increase students' sense of responsibility.
- The INJAZ project, which aims at earning mobile computers at a reduced price alongside a high bandwidth connection for instructors, students and the administrative personnel.
- The LAWHATI project in 2015: targeted all post-baccalaureate learners as well as Moroccan students abroad. Its main objectives are to encourage knowledge sharing and collaborative networking, facilitate learners' access to digital services and resources, generalize ICT in the Moroccan university, modernize pedagogical practices and improve training systems, and finally promote interaction between students and teachers.
- The ITQANE project (Improving Training for Quality Advancement in National Education): is a distance training initiative that targets the improvement of new

skills and competencies in distance training within the instructors' training centers in addition to experiencing contemporary e-training modules.

- ALEF (Advancing Leaning and Employability for a Better Future): a USAID-funded educational project that focused on various aspects of the Moroccan system. The project collaborated with the National Center for Pedagogic Innovation and Experimentation (CNIPE) at the Ministry of National Education (MOE) to design digital learning courses, create an online learning platform Collab.ma, and adapt the national curriculum content to multimedia education.
- MASSAR Program: an information system adopted by the Ministry of Education to implement Information Technology into the academic system. Its main principles are to computerize students' grades, manage exams and to track students' performances by both the teachers and the parents (Elhassani, Alami, Faoubar, & Zaki, 2016).
- The Morocco 1999-2003: a national strategy that sets out Morocco's vision for ICT and its important role in society.
- E-Morocco 2010: a national strategy that was based on eliminating barriers via digital inclusion and ICT sector competitiveness.
- The Digital Morocco 2013 Strategy launched in 2009. The project's primary missions are to give a big push to enhance the way Moroccan businesses interact with technology. At the level of universities, it consists of accompanying them in equipment and teacher trainings (Internet-based technology)
- The latest Digital Morocco 2020 Plan: focuses on speeding up the country's digital transformation, promoting ICT entrepreneurship and supporting its IT status on the international scale (Hathaway & Spidalieri, 2018).

Besides that, due to the huge growth in the numbers of students, some Moroccan universities have opted for online learning especially after the emergence of online platforms such as MOOCs (Massive Open Online Courses) which represent a free online educational invention that offers education to everyone everywhere. Two particularly well known experiences in launching MOOC platforms by the Moroccan universities are Hassan II University of Casablanca (UH2C) (MH2C MOOCs) and Cadi Ayyad University of Marrakech (UCAM) (UC@Mooc) (Laadem, 2016). Additionally, another valuable experience of adopting ICT in higher education is the establishment of Moroccan e-learning centers by the Ministry of Higher Education at Ibn Zohr University Agadir (IZU), Mohammed 5 University of Rabat

(UM5R) and Sidi Mohamed Ben Abdellah University Fez (USMBA) (Ghoulam, Bouikhalene, Harmouch, & Mouncif, 2016).

Indeed, at the level of preparing and developing infrastructure for e-learning technology, it appears that Morocco is pursuing successful policies for the enhancement of the education sector. Nonetheless, various barriers continue to prevail and thus hinder the effective integration and adoption of ICT for educational purposes (Riyami, Poirier, & Mansouri, 2017).

1.5. Summary

The current chapter introduced and reviewed the literature covering various aspects linked to ICTs and notably e-learning as it became vital in engineering education settings. It began by determining the e-learning attributes and its early history. It moreover comprised the sorts of the current online platforms, benefits and obstacles that both instructors and students may face. It also examined the different methods of teaching and learning employed in engineering education in HEIs, it described the students' learning styles as well as the primary features and roles of faculty members. The emphasis was on the students' dissimilarities concerning acquiring various skills and competences in engineering education. The chapter also defined the different assessment tools and activities used in e-learning as well as the implication of effective assessments. It, importantly, revealed the invisible sides of e-learning and to link it to quality assurance in higher education, allowing new opportunities to learners to meet today's labor market demands.

Eventually, the last section examined the theoretical framework used in the current research study, which is founded on constructivist learning theory and connectivism learning theory. Furthermore, it focused on certain theoretical perspectives, innovative practices and new challenges of e-learning in Morocco as well as in other places in the world so as to outlinea narrow framework for efficient implementation of e-learning in higher education.

Chapter Two: Research Methodology and Design

Introduction

A key part of any dissertation or thesis is a research methodology. The research paper can have fruitful findings if it relies on an appropriate theoretical paradigm. Schwandt (2007) describes methodology as a theory of how study should progress. It encompasses examination of the concepts, fundamentals, and methods in a specific approach to research. According to Hilal and Soltan (1993, as cited in Brender, 1997), “a methodology is expected to 1) provide answers to what to do next, when to start it and end it, and how to do it, and 2) provide reasons and assumptions (i.e. a philosophy) for this” (p. 17). The research methodology is both essential and debatable taking into account the overall design, the sampling approaches, the data gathering, the procedures of investigation and the major principles for assessing the study quality levels (Leavy, 2017).

The former chapter offered a thorough examination of the conceptual and theoretical framework relevant to this study. It addressed key principles and samples of important learning theories to determine the main components in implementing e-learning technology within the curriculum of the 21st century higher education (HE). This chapter will provide an exploratory review of the research design and methodology employed in this research project, the research instruments, the population, sampling and data gathering procedures, the variables and analysis strategies.

The mission of gathering the data is challenging since the researcher must choose properly the participants and the conditions. For instance, gathering the data is substantially centered on meeting appropriate contributors who are ready to communicate knowledge truthfully, and the conditions under which the participants were to accomplish and enhance the data (Jonker & Pennink, 2010). The research method that is employed in this paper has been selected based on the mixed method approach so as to collect information, and to gather knowledge concerning the usage of e-learning in Moroccan higher engineering education. It incorporates several components including:

- Presenting a review of the framework of the QUAL, the QUAN, and the mixed method research of gathering data.
- Depicting the target population in the research.

- Gathering the data employing different instruments. The paper-based questionnaire, the web-based questionnaire, and the semi-structured interview (SSI).

The primary aim of the research paper is to smooth the path towards an effective e-learning implementation in Moroccan higher institutions (HEIs); the aim of the current research project is to depict the substantial role of e-learning in teaching higher engineering education. Thus, it was obligatory to examine the Moroccan engineering instructors and learners' digital literacy in the learning milieu and to identify the major factors influencing e-learning implementation. It is worth mentioning that e-learning can promote high standards in student learning outcomes with lowest expenses. Accordingly, the research paper attempts to put to work the contributing determinants of e-learning implementation, and to examine the various restrictive elements that hinder the integration and utilization of the e-learning technology.

To fulfill this, two higher education institutions in Morocco (public and private) were selected to carry out the study; Cadi Ayyad University National School of Applied Sciences Marrakech (ENSA) and the Moroccan School of Engineering Sciences (EMSI). A printed questionnaire (Appendix 1) was directly distributed to students from the chosen educational institutes. Moreover, a web-based survey questionnaire (Appendix 2) was sent by email to faculty members, in addition to a semi-structured interview (Appendix 3) conducted with university teachers.

2.1. Research Design and Data Collection Procedures

Research design is considered as the backbone of good research. Khan (2011) defines research design as "the rational and systematic planning and direction of research…. it is the specific framework in which researcher would collect his data, organize and look at it for the intended result" (pp. 69-70). A research design is central as it guides the theories, methods of the study and the data collection, as well as it investigates the stages of the project (Kumar, 2008). The preparation of a research design for study helps in determining guidelines in which to progress and in understanding precisely what has to be accomplished and how it has to be made at all the phases (Kumar, 2008).

The nature of this research project involves carrying out a mixed methods approach, which includes both QUAL and QUAN data analysis. Hence, the mixed method approach has a range of benefits. Actually, the current research paper is a "front-loaded" kind of research.

According to Durgin and Pilla (2015), “front loaded means that much deliberation, design strategy, and intellectual effort go into developing the hypotheses, specific quantitative techniques, and wording of questions that make up a quantitative research tool” (p. 159). In other words, a lot of work, attention and time should be placed in planning each question to be considered at ‘the front’ of the research. In fact, the research design is a constant operation that requires “tacking back and forth between the different components of the design, assessing the implications of goals, research questions, theories, methods, and validity threats for one another” (Maxwell & Wooffitt, 2005, p. 3).

2.2. Utilization of Well-Established Research Methods

Instruments are tools and means by which the data was gathered, chosen and examined. The present research project is founded on the mixed method approach for further authenticity and validity of the study. The first part of the chapter forms the fundamentals of the quantitative approach (QUAN), the qualitative approach (QUAL), and the mixed methods approach that shapes this research. Gathering data will be directed by a printed and an online questionnaire alongside a semi-structured interview (SSI). The quantitative data will be scientifically examined using SPSS statistical package for analyzing data and running statistical tests, while the qualitative data will be analyzed employing content thematic analysis.

2.2.1 Qualitative Research Method

The Qualitative approach is commonly applied when a researcher is impressed by getting thorough knowledge so as to figure out how diverse elements put together (Spitzlinger, 2006). Croswell (1999) defines qualitative research as “an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words reporting detailed views of informants, and conducted in a natural setting” (as cited in Spitzlinger 2006, p. 6). Unlike Quantitative study, it does not require numerical analysis to provide understanding, thus statistics are insignificant and irrelevant (Gratton & Jones, 2004). It is a more subjective study since it recognizes the function of human factor for research. The QUAL research method involves a variety of techniques of data collection including interviews, participant observations, discourse analysis, etc. QUAL research seeks to figure out and identify a phenomenon from the informant’s perspective.

An effective qualitative research method sets up substantial searching settings about the methodology of the research that is going to be conducted; QUAL method epitomizes former stereotypes, attitudes and emotions. Consequently, qualitative researchers must be attentive so as to master and direct the subjectivity of the discussion of the results. Moreover, the viability of the QUAL research is of great value, to the degree that the study is functional by looking for relevant sites and population to the study. Spitzlinger (2006) claims "qualitative research is characterized by the inductive logic, which allows comprehending a situation without imposing pre-existing expectations on the subject" (p. 6). Shirish (2013) states that there exist diverse research methods that qualitative researchers may employ for data collection. The most commonly used qualitative research methods comprise the following items:

- Ethnographic Research: this approach is also termed "methodology of the people". A case of practical ethnographic study is the study of a specific society and their perception of the role of a specific illness in their cultural background.
- Grounded Theory: it is an "inductive" sort of study founded on the remarks or details from which it was established; it involves a set of information resources, comprising surveys, examination of records, interviews and participant observation.
- Ethical inquiry: it is an intellectual study of ethical issues. It involves the examination of ethics in terms of duties and responsibilities, rights and obligations, decisions, etc.
- Critical social inquiry: employed by researchers to realize how individuals convey and form symbolic meanings.
- Visual methods of data collection: includes maps, photographs, scanned drawings, videos, etc. helping the researcher to identify and form meaning of hidden realities.
- Narrative inquiry: is a way to understand a community's lived experience through narrative forms of representation.

In fact, the QUAL researcher can blend various methods to develop an important consistent research. Apparently, the QUAL researcher directs survey answers to determine, experiences, beliefs, emotions, feelings and attitudes of the informants in order to understand meaning. In this way, the QUAL research requires discipline, hard work, training, creativity and patience.

2.2.2 Quantitative Research Method

When the researcher's purpose is to generalize the results across various situations and circumstances, they usually employ the quantitative approach. Creswell (1994) defines the QUAN method as "an inquiry into a social or human problem based on testing a theory composed of variables, measured with numbers, in order to determine whether the predictive generalizations of the theory hold true" (as cited in Spitzlinger 2006, p.5). In other words, the quantitative approach aims at examining a significant number of populations by employing statistical measurements with numbers through the utilization of surveys or experiments as instruments for data gathering. However, before incorporating surveys in quantitative research, they should be verified and checked for their validity and authenticity, then to choose deliberately the target population. According to Sukamolson (2007, as cited in Balnaves & Caputi, 2001, p. 33) there exist many sorts of quantitative research methods including:

- Survey Research: it involves the utilization of sampling method with a planned questionnaire to measure a particular population's features and behaviors through the use of statistical techniques.
- Correlational Research: this method of research examines relationships between variables. For instance to what degree a correlation occurs between two or more variables within a population.
- Experimental Research: this approach examines a cause-effect relationship. It enables the researcher to dissociate factors so as to examine causal links.
- Causal-comparative Research: it is also called Ex Post Facto Research in which researchers seek to identify the cause or implications of differences that earlier exist between or among groups of people.

Basically, the QUAN approach is used to measure the quantity; it is an effective method for determining beliefs, viewpoints, feelings and behaviors to figure out how the people consider a particular issue. Moreover, it is more realistic and objective than the qualitative research approach, which is characterized as being subjective. Nonetheless, one of the limitations of the QUAN research is that it cannot measure certain notions, thus it is important to combine it with the QUAL methods of inquiry (Kroger, 2007). Correspondingly, the integration of the statistical package such as SPSS permits carrying out several analyses to the research variables and provides thorough knowledge of diverse analytical elements, including the ANOVA analysis, Multiple Correspondence Analysis (MCA), etc.

2.2.3 Mixed Methods Research

"Mixed methods studies are those that combine the qualitative and quantitative approaches into the research methodology of a single study or multiphase study" (Tashakkori & Tddlie, 1998 as cited in Spitzlinger, 2010, p. 6). Being recognized as the third major research approach, mixed methods design is used by researchers to benefit from both QUAN and QUAL approaches in order to obtain more substantial results to the underlying research questions. Mixed methods studies are the sort of research in which an investigator or a team of investigators merge parts of quantitative and qualitative research approaches for the general aims of comprehending a particular issue or problem (Watkins & Gioia, 2015).

The mixed methods research grants a more thorough analytical method than does either qualitative or quantitative approaches alone. Notably, mixed methods design enables the investigator to benefit from the strengths of both QUAL and QUAN approaches and to replace their weaknesses so as to identify phenomena better. For example, mixed methods studies enable the investigator to achieve the five objectives of "mixed methods evaluations" as defined by Greene, Cracelli, & Graham, 1989, as cited in Teddlie & Onwuegbuzie, 2003, p. 353):

- Triangulation: or method triangulation is used in search for intersection and connection of findings from diverse methods examining the same issue. Triangulation offersvarious data by distinct research tools of data collection. Thus, the achieved findings aremore solid, authentic and reasonable.
- Complementarity: aims at obtaining specification, exemplification, and explanation of the findings from one method with findings from the other method. It offers the investigator a broader scope to understand and compare QUAN and QUAL findings.
- Development: focuses on employing the findings from one method to help guide the other method.
- Initiation: aims at detecting discrepancies and inconsistencies that require a reformulation of the research question.
- Expansion: seeks to broaden the scope of research by using diverse methods for diverse research components.

There exist many benefits of mixed methods research. The primary advantage is that by blending qualitative and quantitative research approaches, the deficiency of one may be minimized or prevented; particularly, there is the chance for one to compensate the other's drawbacks (Murray, 2003). There exist further benefits of mixed methods research including:

- Offering thorough data analysis, both objective (QUAN) and subjective (QUAL).
- Allowing examination of both process and result.
- Considering various sorts of research questions.
- Improving credibility of results.

Various research methods are more relevant for different stages of research enquiry; notably, qualitative approaches are adequate for examination of theory generation, and quantification is required later for confirmation and validation. Supplementary and varied sorts of data can enhance the credibility of findings. When there are contradictory results, cautious examination of the contradictions between quantitative and qualitative data can lead to further visions and improve theoretical understanding (Murray, 2003).

2.3. Research Population and Sample

"The target population is the total number of elements of a specific population relevant to the research project" (Neelankavil, 2015, p. 235). Apparently, researchers cannot carry out a study on all the population; therefore, they are required to search for an appropriate list of the population, named the "sampling frame". By working on a sample part from the target population, a researcher can obtain authentic results that can be popularized later on, and thus the study can be accomplished. A well-chosen sampling adds more value to the research project by determining the suitable target population. In fact, it is quite important that the population be outlined appropriately. If the population involves elements that are not part of the designed group, thus questioning a number of them may falsify the findings and make the investigation inaccurate. Likewise, not involving the correct units of the population may impact the sample as it may lead to not questioning some that must have been involved in the research. After identifying the population, the investigator needs to outline the sampling frame. According to Neelankavil (2015), "a sampling frame consists of a list of elements or individual members of the overall population from which a sample is drawn" (p. 240). The sampling process necessitates choosing a sampling technique and defining the sample size. Samples can be chosen involving statistical techniques named probability samples, or they can be chosen by means of non-statistical procedures named, nonprobability samples (Creswell, 2009).

- Probability Samples: are sometimes called "statistical samples" (Anastas, 2000). In these sampling techniques the researcher knows (or can determine with high level of accuracy) the probability that each individual had of being selected to be in the sample. Probability sampling strategies relate to the random choice of members from the target population and attempt to guarantee that every individual involved in the population has a known chance of being chosen in the sample. Procedures such as simple random sample, stratified random sample, cluster sampling, and systematic sampling are some of the most frequently used probability sampling strategies (Schneider & Fisher, 2012).
- Simple Random Sampling refers to a sample in which each element of a particular population has equal chances of being involved in the sample.
- Stratified Random Sample: is realized by dividing the population into reciprocally unique categories or groups, and then outlining simple random samples from each category. This strategy guarantees the investigator that all the distinct subgroups within the population are illustrated in the sample.
- Cluster Sampling: refers to the selection of arbitrary masses or clusters from the population. It involves creating appropriate clusters of units, and then choosing a sample clusters considering them as units by a relevant sampling design.
- Systematic Sampling: is the updated version of simple random sampling in which a list of population is arbitrarily chosen, and from this list the investigator chooses a small size of population.
- Non-probability samples: Do not seek to select a random representative sample from the population interest (Cresswell, 2009). Instead, the non-probability samples refer to the selection of a portion of the specific population being examined founded on particular presumptions and standards. They are effective and practical techniques of choosing a sample in particular conditions (Henry, 1990). Procedures such as convenience samples, most similar/most dissimilar samples, typical case samples, critical case samples, snowball samples, and quota samples are some of the most frequently used non-probability sampling strategies.

The following tables summarizes the non-probability sample designs:

Table 11. *Non-Probability Sampling Designs.* Adopted from (Henry 1990, p. 18)

Type of Sampling	Selection Strategy
Convenience	*Select cases based on their availability for the study.
Most Similar/Dissimilar Cases	*Select cases that are judged to represent similar conditions or, alternatively, very different conditions.
Typical Cases	*Select cases that are known beforehand to be useful and not to be extreme.
Critical Cases	*Select cases that are key or essential for overall acceptance or assessment.
Snowball	*Group members identify additional members to be included in sample.
Quota	*Interviewers select sample that yields the same proportions as the population proportions on easily identified variables

The target population of this research project involves engineering professors and students from the departments of engineering in two Moroccan HEIs, Cadi Ayyad University and precisely focusing on one of its associated colleges the National School of Applied Sciences (ENSA) a public HEI, and the Moroccan School of Engineering Sciences (EMSI), a prestigious private HEI of engineers in Morocco.

The research tends to be more comprehensive so as to investigate thoroughly the various aspects that identify the practices of e-learning implementation, and how it considers the quality of teaching and learning engineering education. Thus, the random sampling design is employed to target the professors and the students in separate departments of engineering in the Moroccan city of Marrakech. All the people involved in the study (professors & students) were knowledgeable about the essence of the research and its intentions before they began to give answers to the questionnaire.

2.4. Research Setting and Participants

In this research, the researcher adopted a simple random sampling method to select the suitable population to take part in this study; mainly professors and students from the departments of engineering in higher educational institutions in the Moroccan city of

Marrakech; namely the National School of Applied Sciences (ENSA) and the Moroccan School of Engineering Sciences (EMSI). They are depicted in the table below:

Table 12. *Population Sample Size Distribution*

HEIs	Sample		Total
	Professors	Students	
ENSA	50	130	180
EMSI	50	130	180
Total	100	260	360

Table 12 illustrates the various components of the sample size comprising the number of participants involved in the study and the research sites. From the 360 sample size above, 308 questionnaires were retrieved, which combines 85.55% answer rate. From the 360 survey questionnaires, 33 were incompatible due to lack of information and incoherent answers, thus, they were eliminated. Moreover, the other 19 were not retrieved from the very start. Actually, the 308 were separately examined, 80 for professors, and 228 for students. In effect, the total questionnaire 308 constitutes 85.55%, which reveals that the sample size is still representative for the population.

The two institutions selected for this research project were the National School of Applied Sciences (ENSA) and the Moroccan School of Engineering Sciences Marrakech (EMSI). Without any type of discrimination, the selected institutions were by chance, and here are certain distinctive aspects for these institutions as being the search sites for this research project:

- The National School of Applied Sciences (ENSA): is a public institution at the Cadi Ayyad University in Morocco, which is known as the leading university in Morocco as well as one of the best universities in the 2018 list of emerging economies in Africa and the Maghreb area. ENSA was established in 2000 by the Ministry of Higher Education and Research with the aim of preparing and generating high quality engineers via advanced and modern instructional methods. The school grants diverse courses in the engineering cycle including: Computer engineering, Telecommunication and Networks engineering, Electrical engineering, and Industrial engineering and logistics (ENSA, 2016).

- The Moroccan School of Engineering Sciences Marrakech (EMSI): established in 2004, EMSI is a reputable and well known private institution of engineers in Morocco. It is acknowledged by the world professionals as the first private engineering institution in Morocco as reported by the Diorh Campus Mag- 2017 Barometer, as well as itrepresents the Union of the Moroccan Inventors at the international level. EMSI is a multidisciplinary engineering institution which grants a program of study and training accredited by the Moroccan state including two fields of study: Engineering and Finance. The school offers different training programs comprising IT and Network Engineering, the Engineering of Automation and Industrial Computing, Industrial Engineering, Civil Engineering, Buildings and Public Tasks. In 2016, the school extended its offering to incorporate study programs in Financial Engineering, Accounting, Control and Auditing (EMSI, 2016).

The fact of being a teacher in both institutions helped a lot in the gathering of information, adding to that the great support and assistance received from the administrative staff in both sites.

2.5. The Variables of Interest

Variables are concepts examined in a research study so as to make the hypothesis accurate and uncomplicated to both the investigator and examiner (Rubbin & Babbie, 2010). Variables are mainly adopted to reflect the research question of interest. The principle variables have been considered from the theoretical framework in chapter three, the variables operationalization actually grants valid working plan for reliable findings. The following figure represents the main and different variables used in this research project:

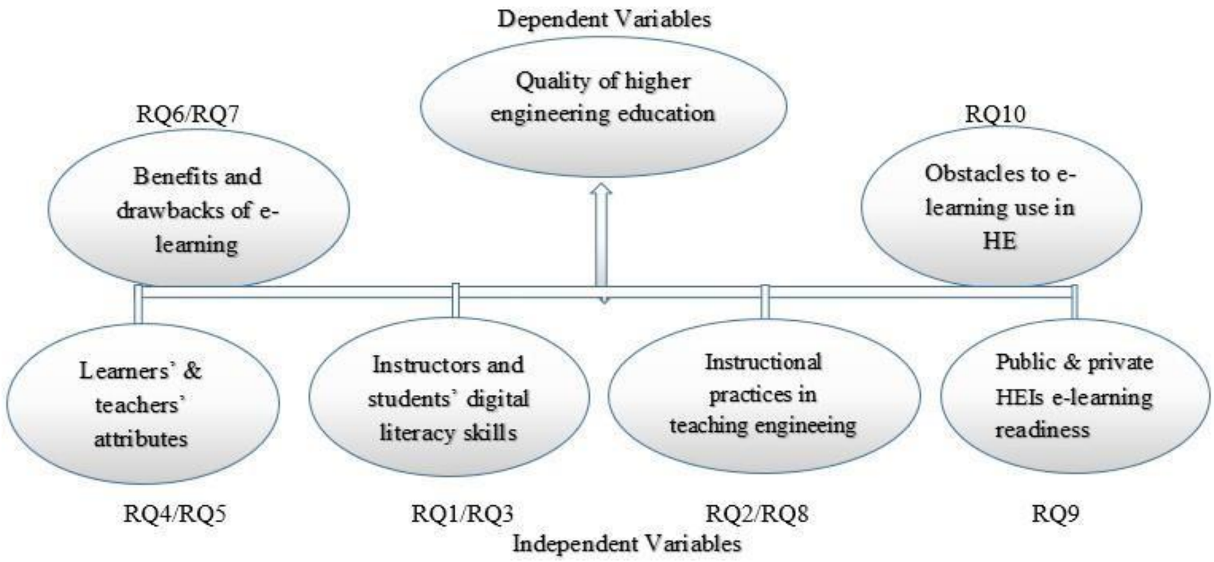


Figure 11. *Design of the Variables of Interest*

"A dependent variable is an outcome variable that is thought to be determined or influenced by an independent variable" (Jaccard, 2001, p. 12). It is the focus of the study under investigation and is the process the investigator desires to interpret, identify, and anticipate. In the present research project, higher engineering education quality as a dependent variable is carried out with regard to the degree to which quality of learning engineering is considered, as well as students' performance and instructors' professional development.

"Independent variables also referred to as exposure or risk factor variables are defined as hypothesized causal factors in a theoretical model" (Friis & Sellers, 2004, p. 516). Independent variables are manipulated, chosen, and measured characteristics by which the researcher identifies a particular phenomenon, besides they are the presumed cause of the dependent variable (Ariola, 2006). In this research study, the independent variable e-learning has been carried out with regard to the use of different e-learning tools, expectations and predictions for online learning. Besides, the instructors and the learners' features have been carried out with reference to the population parameters, competencies, experience, consciousness, and perceptions of e-learning and traditional teaching methods. Eventually, the digital knowledge has been carried out in terms of the time devoted to using the virtual world, employing technology for learning objectives, surfing the Internet, operating electronic instruments, and possessing different technology devices.

2.6. Data Gathering Tools

"Construction of data collecting devices is an important task of researcher. A researcher needs many data gathering tools and devices, which may vary in their complexity, design, administration and interpretation" (Khan, 2011, p. 97). Thus, various and varied research tools were adopted to gather the appropriate data. The research design was initially planned; correspondingly, more than a research tool were employed to gather data. The study attempts to provide a thorough understanding of e-learning applications in Moroccan HEIs which brings to light the hidden notions and realities about the issue of e-learning implementation.

Moreover, multiple methods were used to gather data required for the study by introducing method triangulation so as to maximize the validity of the research. Data were gathered by means of printed and online questionnaires, which incorporate great range of elements; they included close-ended questions and certain open-ended questions. The web-based questionnaire was directed to the professors and the paper-based questionnaire was administered to the students in the departments of engineering in the selected HEIs. The survey technique was selected since the target sample was huge. The questionnaire was of great significance because the principle features of the study are being analytical and explanatory. Additionally, a semi-structure interview (SSI) was adopted to identify the instructors' perceptions and attitudes towards e-learning technology.

2.6.1. The Survey Research

Questionnaires are of great significance to the success of a research. "The questionnaire is a well-established tool within social science research for acquiring information on participant social characteristics, present and past behavior, standards of behavior or attitudes and their beliefs and reasons for action with respect to the topic under investigation" (Bulmer, 2004, as cited in Bird, 2009, p. 1). It is the main means of collecting quantitative data using various measures so as to produce profound knowledge that might not be achieved through other methods. In this research project a printed questionnaire as well as an online questionnaire were outlined with the aim of examining and determining the primary objective of the research.

2.6.1.1 The Paper-Based Survey

The paper-based questionnaire was randomly administered to college students and precisely targeted undergraduate students who have successfully completed at least one semester (Appendix 1: questionnaire for students). The Sample population was randomly chosen without any kind of discrimination, and it incorporated students involved in the departments of engineering with the two Moroccan HEIs as representative research sites. It was a self-administered survey founded on the research questions to get certain basic information about the informants and the issue of e-learning. The questionnaire is made up of seven sections including perceptions, knowledge, competences, and consciousness. The survey is split into several thematic sections:

The first section is dedicated to academic and social background information comprising age, gender, educational level and school name. The next section attempts to examine students' prior knowledge of information technologies (IT) including the Internet access, use and ownership of different technology devices, use of digital tools, etc. Besides, the section also examines students' familiarity with e-learning tools used for learning engineering education. The third section deals with students' digital skill levels and attitudes towards educational technology.

Section four involves a Likert scale ranging from (1= Excellent) to (5=Very low) in which learners were asked to evaluate different educational e-resources and facilities in their institution. Section five attempts to examine the learners' perceptions and expectations of the effectiveness of e-learning in learning engineering; the utilization of a five-point Likert scale instrument was of considerable significance to evaluate students' perceptions and expectations, the students were expected to rate a set of statements related to e-learning use in learning engineering.

The sixth section includes a Likert-type scale in which participants were required to rate their satisfaction level with the traditional teaching paradigm in their departments ranging from (1= Highly satisfied) to (5= Highly dissatisfied). Finally, the seventh section provides a list of key drivers for an effective implementation of e-learning technology in education. The students were presented with a rating scale and asked to rate the importance of 6 different factors leading to successful e-learning adoption ranging from (1= Absolutely essential) to (5= Slightly important).

2.6.1.2 The Web-Based Survey

The technique of the web-based questionnaire was adopted to gather the data from professors from the engineering departments (Appendix 2). It attempts to collect certain principle information about university teachers and the research topic under investigation. In this research study, the online questionnaire was written in French and then translated into English since not all of the respondents can speak, write and understand the English language. It consists of three main sections:

The first section contains questions linked to personal background information comprising age, gender, workplace, years of the teaching experience. The second section deals with the teachers' technology usage (use and ownership of computers, access to the Internet, comfort level with digital tools, use of diverse ICT tools in their classes etc.). The third section examines the lecturers' familiarity and attitudes towards educational technology in engineering education, their prior knowledge of e-learning systems, their digital skill level and the kind of training programs they received to improve their ICT competencies. Besides, the section aims to explore the teachers' perceptions towards e-learning through citing some of its benefits and drawbacks when adopted for teaching engineering. The section also investigates the different factors that influence the integration of e-learning in Moroccan higher education settings.

2.6.2 The Interview's Structure

Because they provide an effective way to gather great amounts of data rapidly, interviews are the second technique used for data gathering in this research project. Gillham (2000) defines an interview as "a conversation between two people in which the interviewer seeks particular responses from the interviewee" (cited in Inglebey & Oliver, 2008, para, 5). There exist various types of interviews with different protocols including structured interviews, semi-structured interviews, and focus groups interviews (Walliman & Bukler, 2008). The interview study can be realized based on three phases; the first phase is the pre-interview in which the interviewer formulates the questions, appoint the suitable respondents and determine the date and location of the interview. The second phase deals with carrying out the interview, and generally the discussion must be constructive and valuable. The last phase is the post-interview, in which the interviewer is required to reproduce the data, check it, examine it, and communicate the final findings (Anderson & Arsenault, 2005).

2.6.2.1 The Semi-Structure Interview (SSI)

The semi-structured interview (SSI) was carried out at two Engineering HEIs in the Moroccan city of Marrakech with sixteen interviewees; eight from the National School of Applied Sciences (ENSA) which is a public HEI and eight from the Moroccan School of Engineering Sciences (EMSI) a private one. The table below represents the interviewees' profile. T1, T2, T3…T16 represent the teachers or the interviewees, whereas Pub (Public) and Pvt (Private) represent the type of the institution. The interview was in a semi-structured format (Appendix 3) containing already designed content questions, however the respondents were granted full liberty to express their opinions in their own words, while the interviewer could modify or eliminate particular questions based on the discussion of the interview. In this research, professors from engineering departments were interviewed involving a semi-structured interview format so as to define and gain insight into particular topics related to the research study. It is worth mentioning that the interview guide was formulated in English, and then translated into Arabic. Actually, the interview was conducted using Arabic as a source language since the interviewees were non-English speaking. The researcher conducted the interview herself so that she could evaluate the respondents' veracity, clarify unclear responses and to ensure that data are collected in a consistent manner. Eventually, the obtained data were translated into English by the researcher, coded and analyzed using qualitative thematic analysis.

The first section was devoted to the characteristics of the respondents and their various dimensions of ICT use in education. Comprehensive data about the experiences of the participants and the applications in their departments of engineering as initial efforts of implementing electronic learning in the learning process have come into view.

Table 13. *Interviewees' Profile.*

Interviewees	Institution	Gender
T1	Pub	Male
T2	Pub	Male
T3	Pub	Male
T4	Pub	Male
T5	Pub	Male

T6	Pub	Female
T7	Pub	Female
T8	Pub	Female
T9	Pvt	Male
T10	Pvt	Male
T11	Pvt	Male
T12	Pvt	Male
T13	Pvt	Female
T14	Pvt	Female
T15	Pvt	Female
T16	Pvt	Female

The second section of the interview placed great emphasis on the main RQs underlying the research. The questions emphasized the elements that could be significant in the effective application of e-learning and those obstacles that impede the implementation steps. Concerning the third section of the interview, the respondents clarified how they deal with the current advances in technology in line with the new generation of digitalized learners. Eventually, the last section was dedicated to the teachers' recommendations and guidelines for successful e-learning integration. The interviewer spent 20 minutes and sometimes 30 minutes to conduct the interview, based on the reaction of the respondents and their availability that day. The findings were taped as well as hand recorded and were subsequently refined, employed and then interpreted using thematic content analysis approach, since it constitutes a step-by-step process that helps the researcher in generating codes and patterns for easy interpretation of findings leading to a more comprehensive understanding of the phenomenon (Polio & Friedman, 2016).

2.6.3. Administration of Research Instruments

The researcher administered all the research instruments to all survey participants by herself. This enabled the researcher to gather first-hand information. The printed questionnaire was self-administered to students and were given sufficient time to complete them. The online questionnaire was sent to university teachers via electronic mail and they were also given adequate time to fill them. Moreover, the researcher conducted a SSI with some lecturers and notes were taken for data analysis.

2.6.4. Pilot Study

"The aim of a pilot study is to try out the research approach to identify potential problems that may affect the quality and validity of the results" (Blessing & Chakrabarti, 2009, p. 114). In this research project, to test the effectiveness of the survey instrument, a pilot test study was conducted after designing the questions and before moving to the distribution in the field. Concerning the teachers' questionnaire, a web-based version was dispatched via electronic mail to nearly 15 colleagues who work as professors in both research sites (EMSI & ENSA). As concerns the students' survey, 22 students from both institutions received a printed version of the questionnaire.

The questionnaires to pilot participants were administered in the same way as it was expected to be administered in the principle study. Participants were required to determine the major ambiguities and vague questions, as well as to provide certain suggestions and/or recommendations. After the full pilot, relevant and essential changes were made at the level of the teachers and students' questionnaire design, such as introducing new questions and eliminating others, including some instructions, and modifying the scale. This piloting was, indeed, significantly useful in examining the feasibility of the measures by guaranteeing that questions are worded correctly and well understood by the participants. In fact, the purpose of pilot study was to test the appropriateness of the items to the participants in order to develop the research instruments and thus improve the validity of the tools.

2.6.5. Components of the Research Instruments

2.6.5.1 Components of the Paper-Based Survey

The students' survey (Appendix 1) was designed to analyze the entire aspects of the research questions in order to obtain reliable and valid findings. The researcher was inspired by a doctoral dissertation on e-learning integration in Moroccan universities prepared by M. Laadem (2016). Particularly, the questionnaires implemented in this research propelled the researcher's interest to study the implementation of e-learning in engineering departments. Therefore, the researcher found the questionnaires very useful and adapted them through removing and adding items to fit the present study. The paper-based survey combined seven sections including 31 questions; full details regarding the components of the survey are introduced in table 14 below:

Table 14. *Components of the Students' Survey*

sections	Sort of Questions	Number of Questions	Description
First	Closed items linked to learners background information	4	Sex/Age/Institution/ Educational Level
Second	Mixture of closed and open items linked to learners' digital skills and technology usage	12	The digital competence of the respondents regarding the use of the laptop, the Internet...etc.
Third	Mixture of closed and open items linked to learners' attitudes towards educational technology in engineering Institutes	11	The respondents' attitudes towards e-learning integration in higher education
Fourth	Likert scale-Evaluation of the e-resources and facilities in engineering institutions (7 items)	1	The respondents' evaluation of the pedagogical facilities and e-resources in the departments of engineering
Fifth	Likert scale-Students' perceptions and expectations on the effectiveness of e-learning (9 items)	1	The respondents' expectations and views of e-learning
Sixth	Likert Scale-Satisfaction with the traditional teaching paradigm (7items)	1	The respondents' satisfaction level with different issues related to the conventional teaching paradigm
Seventh	Likert Scale-Evaluation of the factors promoting the adoption of e-learning technology in higher education (6 items)	1	The respondents' evaluation of the factors leading to a successful implementation of e-learning

2.6.5.2 Components of the Web-Based Survey

The online surveys are easier to be designed than paper-based surveys. Murther (2008, as cited in Merrill, 2011) describes online surveys as "a cost effective, time saving technique to reach a global set of participants and the ease of implementing structured responses, adaptive questions, and social point-and-click" (p. 30). Web-based questionnaires have become a standardized data gathering method in today's networked setting; they permit researchers to conduct international large scale surveys and help them spread relevant information to their target population (Merrill, 2011). The diverse menu items and icons suggested by the website enable the researcher to gain time and effort to consider which sort of questions are adequate or which sort of responses have to be offered. The online survey tool adopted in this research project is based on 'Google Forms'[1], the website grants several choices to design the online survey and to well plan it. Furthermore, online survey tools are visually more appealing than the printed questionnaires; researchers can modify backgrounds, include color and animation to put together an attractive questionnaire and thus enhance the participants' collaboration and readiness to fill in the questionnaire (Sikaraya-Turk & Uysal, 2011). The attractive features of the web-based survey including the colors, the layout, the graphics, and the active boxes prompt the participants to take part willingly in the questionnaire.

Besides, the web-based survey can be designed on paper, checked and tested for validity before introducing it in the website. A further benefit of the web-based survey is that it frees the investigator from visiting the research sites and search for respondents, indeed the investigator can dispatch the link of the web-based survey to the participants via various mediums such as emails, social networks, or as an instant message.

In this research study, the teachers' online questionnaire (Appendix 2) included three major sections referring to the teachers' characteristics and common knowledge, the degree of ICT use, the methods of teaching engineering in the classroom either by using conventional methods or by employing various technological tools, and eventually the instructors' attitudes towards the use of e-learning in education. In fact, the teachers were required to complete a short questionnaire by the mere fact that the majority of them do not possess enough time and thus they quickly get bored when they encounter too many questions with the same format. The questionnaire included 28 items segmented into 3 sections; the details regarding the content of the survey are presented in the table 15 below:

Table 15. *Components of the Teachers' Survey*

Sections	**Sort of Questions**	**Number of Questions**	**Description**
First	Closed items linked to teachers' demographic Characteristics	4	Sex, Age, teaching experience and workplace
Second	Mixture of closed and open items linked to teachers' digital skills and technology usage	6	*The digital competence of the respondents regarding the use of the laptop, the Internet...etc. *Comfort level with technology

[1] The online questionnaire is available at :
https://docs.google.com/forms/d/1slIFvaiugHJal2oQTIH_-oxMb0R8KtaLVPA5DcxyI3E/edit

Third	Mixture of closed and open items linked to teachers' familiarity, perceptions and attitudes towards educational technology in engineering institutes	18	The respondents' views of e-learning integration in higher education

2.6.5.3. Design of the Survey Instruments

The design of a survey is essential to the success of any study. Designing an appropriate survey questionnaire is not easy. A wrongly designed one can bother the participants and thus influence the quality of the data gathered, or even generating biased findings (Needham, 1999). First, the investigator should pretest the questionnaire before starting the data collection; this implies that a first questionnaire draft is necessarily required. "Pretesting, like a dress rehearsal before opening night, is one of the most important components of a survey" (Czaja & Blair, 2005, p. 20). Second, the researcher needs to define the type of the questions and to realize a particular degree of validity. In some cases, it is necessary to reproduce certain questions in different ways or to reword the content as a sort of making sure of the provided answers of the same participant. Eventually, the investigator classifies the sections or subsections of the survey by separating the items in terms of their connection with the theme of the section (Czaja & Blair, 2005).

Accordingly, the questions need to be precise, coherent and unambiguous to prevent unclearness, doubt and misunderstandings and that all respondents must be able to understand the terms used in the same way (De Leeuw, Hox, & Dillman, 2012). Furthermore, the questions must follow a logical order starting from common issues to precise and targeted details. In this sense, Dillman (2002, as cited in Schaller, 2005) proclaims "the first question should be easy to answer, apply to all respondents, be interesting, and be clearly connected to the purposes and topic of the survey" (p. 32). The questions employed to shape the components of the survey tool were of two formats: open-ended and closed-ended questions (Du Plooy, 2002).

The majority of questions in a survey are determined by the research aims. The researcher must keep the research questions in mind so that the data collected are relevant to the research paper (Whitcomb & Clarke, 2000). Therefore, the research questions define the form of the questions that have to be addressed to the respondents. Generally, there exist two basic formats of questions: the closed-ended and open-ended; the closed-ended questions provide the participant with a constant set of choices including the 'yes' or 'no' answer, or a set of options that the participant needs to encircle or click. This sort of questions is popular with investigators since it guarantees a fixed set of responses from participants and thus makes the encrypting and encoding process of data somewhat simple. Whereas the open-ended questions (also called unstructured items) require respondents to form their own answers to the survey questions (Smith, 2010).

Both the teachers' survey and the students' survey consisted of mostly closed questions and a few open questions. The closed-ended items take several formats including:

- Rating scale questions: respondents are required to rate an attribute or feature, such as the items provided in the fourth section (poor/low/neutral/good/high) (Appendix 1).
- Dichotomous questions: respondents are expected to provide a 'yes' or 'no' response, like in the second, third, and fifth sections (Appendix 1).
- Likert scale questions: are used to elicit behavioral or opinion data, participants are expected to indicate an answer on an explicit scale, such as in the sixth section (Very satisfied/ satisfied/ neutral/ dissatisfied/ very dissatisfied) (Appendix 1).
- Multiple-choice questions: respondents are expected to select one or more responses from a given list of answer options, like the items in the third section (Appendix 2)

2.6.5.4 Components of the Semi-Structured Interview

A semi-structured interview (SSI) is defined as "a guided conversation in which only the topics are predetermined and new questions or insights arise as a result of discussion and visual analysis" (De Satgé, 2002, p. 8). In this research project, a semi-structured interview was formerly predetermined before carrying out the interviews with the participants. The initial step was constructing the questions that were straightforward, short and adaptable; "long questions, questions that include jargon, confusing questions, and questions that are biased" were avoided (Ary et al., 2018, p.434). Accordingly, a semi-structured interview (Appendix 3) was planned following a sample form, the opening part included a friendly greeting and a cordial reception so as to facilitate and enhance rapport, and therefore the interview questions were raised in an open and flexible manner.

The first point was essentially linked to the experiences of the participants in employing modern computer technology in their teaching of engineering. The next and third items put emphasis on the research questions linked to the factors and obstacles for an effective integration of e-learning in education, and the last point was dedicated to further comments and suggestions from the respondents about the practices of e-learning in the department of engineering. Eventually, the researcher expressed profound appreciation to all the respondents for their significant and valuable contribution to the research.

When dealing with a semi-structured interview, the investigator must allow more room for the interviewees to get comfortable with the questions and to express their thoughts without being pressed or influenced; "the interviewer follows a process of observe, think, test, and revise as the interview proceeds" (Cramb & Purcell, 2001, p. 47). Normally, the types of questions in a semi-structured interview are in the format of open-ended items so as to make the discussion flexible between the interviewer and the respondents, taking into account the importance of moving from general information to more specific information. In this research project, the interview protocol consisted of the following questions:

1. Would you mind if we talk about your experience of employing modern computer technology in teaching engineering?
2. What kind of benefits can professors and students receive from employing e-learning in teaching and learning engineering?
3. What are the challenges and obstacles that hinder the successful integration of e-learning in higher education?
4. Do you suggest additional recommendations or propositions about the practicality of e-learning in the departments of engineering?

The designed questions made the interview uncomplicated and enjoyable for both the respondents and the interviewer. The interviewees showed a strong sense of cooperation in offering the precise answers, and through their facial gestures majority of respondents intended to be reasonable and truthful regarding their own experiences of teaching engineering in the classroom.

2.7. Validation of Data Collection Tools

Validity is an important aspect of an effective research. If research instruments are not valid may affect the effectiveness of a research. Thus, validity of data collecting instrument is very significant for both QUAN and QUAL research. Validity is "the degree to which researchers actually have discovered what they think their results show, and how applicable the results are to other populations" (Schensul, Schensul, & LeCompte, 1999, p. 271). Generally, validity is associated with preciseness and credibility of tools and observations, as well as with the extent to which findings achieved by investigators "make sense to and are shared by the people studied and can be generalized to other populations" (Goetz & LeCompte, 1984 as cited in Schensul, Schensul, & LeCompte, 1999, 274). Whereas reliability is defined as "the degree to which a measuring instrument is consistent over time on measures for similar populations" (Miller, 2013, p. 20). Accordingly, certain variables might be well measured whereas others might not. Therefore, when carrying out different analyses, identical findings must be produced so as to demonstrate their validity.

2.7.1 Validity and Reliability of the Questionnaires

Both surveys for students (Appendix 1) and teachers (Appendix 2) were verified for their reliability and validity before they were dispatched to the participants. In the current research study, the researcher used the statistical measurement called Cronbach's Alpha to test the internal consistency reliability of the survey instrument. Cronbach's alpha is a well-known measurement test for evaluating the internal reliability of survey items; it indicates how well the items are positively correlated to one another (Creswell, 2009). The online and printed questionnaires were checked for their reliability in the first place, then for their content validity. The following tables (16/17) present the reliability statistics of the survey instrument:

Table 16. *Detection Coefficient of Cronbach's Alpha on Teachers' Survey Variables*

Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**	**Interpretation**
,719	,716	28	Acceptable

.

Table 17. *Detection Coefficient of Cronbach's Alpha on Students' Survey Variables*

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Interpretation
,723	,701	31	Acceptable

Overall, the value of the Cronbach's alpha test for both questionnaires is more than 0.70, which indicates that all variables are reliable and can be used for further analysis. However, although the surveys are reliable, this does not mean that they are valid. In this regard, the researcher adopted Face Validity Index (FVI) and Content Validity Index (CVI) to assess content validity of the survey instrument. Content validity index is the most commonly used method to calculate content validity quantitatively (Creswell, 2009). Tables 18 and 19 present the validity statistics of the survey instrument.

Table 18. *Summary of Content and Face Validity Results of the Teachers' Survey*

Tests	Variables	Value
Content Validity Index (CVI)	CVI-Relevancy	0.730
	CVI- Representativeness	0.720
	Total	0.715
Content Validity Index (FVI)	FVI-Comprehension	0.810
	FVI-Clarity	0.822
	Total	0.816

Table 19. *Summary of Content and Face Validity Results of the Students' Survey*

Tests	Variables	Value
Content Validity Index (CVI)	CVI-Relevancy	0.765
	CVI- Representativeness	0.787
	Total	0.741
Content Validity Index (FVI)	FVI-Comprehension	0.798
	FVI-Clarity	0.781
	Total	0.756

To ensure both face and content validity, the paper-based and online questionnaires were given to an expert to assess the extent to which the instrument‘s items match its objectives, and to see whether the different items of the instruments cohere well; eventually, content validity index and face validity index were calculated. According to the expert judgments, content validity index for the teachers' survey was 0.715 and face validity index was 0.816 (see table 16), while content validity index for the students' survey was 0.741 and face validity index was 0.756 (see table 17). The results imply that both questionnaires are valid and could be used to measure the extent to which e-learning manifests in the Moroccan context and to measure also the factors impeding its successful integration.

2.7.2. Validity and Reliability of the Interview

An interview in the context of survey research can be defined as "a face-to-face interaction between two people in which one person (interviewer) asks questions by means of a questionnaire and the other person (respondent) answers these questions" (Loosveldt, 2012, p. 201). Thus, the notions validity and reliability are of less relevance when dealing with interviews, whereas the notion suitability is simultaneously employed (Seidman, 2006). The conversational exchange between the interviewer and the respondent can be subjected to diverse interpretations, where the investigator cannot decide whether the respondent is honest or dishonest, or whether the responses offered are reliable or not. In fact, the researcher "should act as a kind of sponge, soaking up the interviewees' comments and responses, i.e. the interviewer is a kind of collection data device" (Wellington, 2000). Actually, the use of interviewing method can grant a chance to gather extra information that cannot be obtained by other instruments (2006).

2.8. Summary

This chapter provided an overview of the research methods, design, tools and the instruments employed in the gathering and analysis of the data with the objective to explain the various stages in the research process. In broad terms, the research methods, techniques and instruments were thoroughly explained and profoundly examined. Besides, the chapter offered more description and detailing of the printed and online surveys design as well as the interview's layout. Likewise, the variables were approached so as to examine their reliability and viability in connection with the research questions. Eventually, the sorts and the forms of the adopted questions were discussed in thorough analysis of establishing valid research tools.

The following chapter attempts to describe, classify, and analyze the findings of the collected data. The data gathered will be presented and thoroughly examined based on the diverse research tools; beginning by the paper-based survey.

Chapter Three: Presentation of Findings and Data Analysis of the Paper-Based Survey

Introduction

The former chapter posited that this research study embraces a combination of approaches to gather data in an effort to confirm or reject the hypotheses and to offer tentative answers to the research questions. Therefore, survey questionnaires were administered to obtain quantitative data from the target population, particularly teachers and students from higher engineering education institutions. Besides, an interview protocol was designed to the teachers to collect further data. Green, Ottoson, & Roditis (2020) state that "triangulation involves the accumulation of evidence from a variety of sources to gain insight into a particular topic, and it often combines quantitative and qualitative data….it is often beneficial because of the complementary nature of information from different resources" (p. 476).

The present chapter attempts to describe, classify, and analyze the data gathered. It discusses the results of the paper-based survey administered to students. Data analysis is "the process of computing various summaries and derived values from the given collection of data" (Mirkin, 2011, p. 1). For the survey questionnaires, the Statistical Package for Social Sciences (SPSS) was adopted as the basic tool for statistical analysis. SPSS is an effective and powerful tool for manipulating and deciphering survey data. Both descriptive statistical techniques (percentages, standard deviation, means, frequencies, reliability analysis) and inferential statistics (Chi-Square tests, Spearman's Correlation tests, ANOVA tests, Multiple Correspondence Analysis (MCA), to cross tabulate and compare the results) were employed in this study.

3.1. Findings of the Students' Survey

One of the major objectives of this research paper is to examine the applications of e-learning and its current practice in Moroccan higher engineering education. It also attempts to identify the factors that impede its use and adoption in teaching and learning. In this regard, Rogers (1983) claims that in order to measure the rate of adoption of an innovation, it is significant to take potential adopters' attitudes and perceptions as a determinant predictor. Accordingly, another aim of this study is to examine students' attitudes towards e-learning since they have been considered as critical to the success of e-learning technology. This chapter attempts to introduce the findings on the experiences and attitudes towards e-learning from students at two Moroccan Higher engineering institutions. An analysis of relationships between learners' attitudes and their demographic characteristics, familiarity with technology, adoption of technology for learning, digital skills, awareness, satisfaction, expectations for future classroom technology, and perceived advantages and disadvantages of e-learning is also considered.

This chapter discusses the results of the printed questionnaire administered to the students. In an early stage, a demographic description of the respondents' profile is provided based on the univariate analysis (analysis of a single variable), succeeded by a statistical analysis of the principle survey's elements. The findings are described in charts and tabulations in an attempt to grant transparency and preciseness to data.

3.1.1. Description of Respondents

The current section presents a thorough description of the background information of the respondents who participated in this study by filling in the printed survey questionnaire before discussing the core data meant to investigate the applications of e-learning in Moroccan Higher engineering education.

The survey was distributed to 240 students from public and private higher engineering institutions during the months of February and March 2017. The institutions were both located in the Moroccan city of Marrakech. A total of 228 surveys were retrieved which combines 95% response rate, which reveals that the sample size is still functional to be representative for the population. The following table shows the distribution of students according to the research sites:

Table 20. *Distribution of Frequency and Percentage of Respondents by Institution*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	EMSI	110	48,2	48,2	48,2
	ENSA	118	51,8	51,8	100,0
	Total	228	100,0	100,0	

From table 20, it appears that the sample population is composed of 48% of students from the Moroccan School of Engineering Sciences (EMSI) with a number of 110 respondents, which represents the private sector, and 52% of students from the National School of Applied Sciences (ENSA) with a number of 118 respondents, which represents the public sector.

3.1.1.1. Respondents' Gender

The first question the respondents were asked to identify is their gender. As table 21 illustrates, the total number of respondents was 228 from the two research sites. They were distributed between 132 males and 95 females; the number of male respondents represents 58%, which is higher than the number of females, which only represents 41, 9%.

Table 21. *Distribution of Frequency and Percentage for Respondents' Gender*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	132	57,9	58,1	58,1
	Female	95	41,7	41,9	100,0
	Total	227	99,6	100,0	
Missing	System	1	,4		
Total		228	100,0		

3.1.1.2 Respondents' Age

The respondents in this study belong to higher education institutions. In the survey, they were split into four separate groups; the first group from 17 to 25 years old, the second group from 26 to 35 years old, the third group from 36 to 40 years old, and the last group above 40 years old. From table 22 it appears that the sample population belongs only to the first and second age categories with a number of 211 of respondents who belong to the first group representing 92, 5%, while the second group represents 17, 5% with a total number of 17 participants.

Table 22. *Distribution of Students According to Age*

.

.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	[17-25]	211	92,5	92,5	92,5
	[26-35]	17	7,5	7,5	100,0
	[36-40]	0	0	0	0
	40-above]	0	0	0	0
	Total	228	100,0	100,0	

3.1.1.3 Respondents' Level of Education

In addition to gender and age, respondents were also requested to identify their educational level. The 228 participants in this research study were undergraduate students from the engineering departments of two higher education institutions (EMSA & EMSI). The education level of the participants ranged from first year of college to the third year. It is noted from the table 23 below that the highest frequency is 108 respondents of the first year representing 47.4%, followed by second year students (30.3%, N=82), then third year participants with a total number of 51, which constitutes 22.3% of the sample.

Table 23. *Distribution of Frequency and Percentage of Participants' Level of Education*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1st year	108	47,4	47,4	47,4
	2nd year	69	30,3	30,3	30,3
	3rd year	51	22,3	22,3	100,0
	Total	228	100,0	100,0	

3.1.2. Students' Use of Technology

The second section within the questionnaire was designed to investigate the extent to which the respondents use technology in their everyday life. Respondents were asked about their use of computers, amount of time spent on the Internet and ownership of technology devices. Students' use and access to technology represents a primary factor that would shape their attitudes towards e-learning as well as their willingness and readiness to use it.

3.1.2.1. Ownership of Technology Devices

Table 24. *The Frequency for Technology Devices Ownership*

Do you Own a Technology Device

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	204	89,5	98,6	98,6
	No	3	1,3	1,4	100,0
	Total	207	90,8	100,0	
Missing	System	21	9,2		
Total		228	100,0		

As table 24 presents, 89.5% of the respondents have access to technology equipment with a total number of 204, while only 3 respondents claimed not to have a technology device, they constitute 1.3% of the population.

Table 25. *The Frequency for Types of Technology Devices Owned by Students*

		Responses		Percentage of Cases
		N	Percentage	
Which device do you own [a]	Desktop computer	77	16,8%	34,1%
	Laptop	151	33,0%	66,8%
	Tablet	42	9,2%	18,6%
	Cell/smart Phone	187	40,9%	82,7%
Total		457	100,0%	202,2%

a. Dichotomy group tabulated at value 1.

As Indicated in the table 25 above, the mostly used technology device is the Smartphone (82.7%), in second position we find the laptop (66.8%), then the desktop computer (34.1%), and in the last position the tablet with a frequency of only 18.6%. From the same table, we also notice that the majority of respondents do own more than one technology equipment, the thing that may positively impact their learning.

3.1.2.2. Time Spent on the Internet

Table 26. *The Frequency of Students' Spent Time on the Internet*

I Spend Approximately on the Internet

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	,5	1	,4	,4	,4
	1,0	5	2,2	2,2	2,7
	1,5	1	,4	,4	3,1
	2,0	15	6,6	6,6	9,7
	3,0	48	21,1	21,2	31,0
	4,0	27	11,8	11,9	42,9
	5,0	8	3,5	3,5	46,5
	6,0	55	24,1	24,3	70,8
	7,0	3	1,3	1,3	72,1
	8,0	13	5,7	5,8	77,9
	9,0	1	,4	,4	78,3
	10,0	3	1,3	1,3	79,6
	11,0	19	8,3	8,4	88,1
	11,5	19	8,3	8,4	96,5
	12,0	4	1,8	1,8	98,2
	16,0	1	,4	,4	98,7
	18,0	1	,4	,4	99,1
	24,0	2	,9	,9	100,0
	Total	226	99,1	100,0	
Missing	System	2	,9		
Total		228	100,0		

Respondents were also asked to report the amount of time they spend on the Internet per day. On average, respondents spend 6 hours per day on the Internet (24.3%, N=55) (see table above) with a range of 23.5 hours (24h Maximum - 0.5h Minimum) (See table 27 below) of which only one student reports 0.5 hours of Internet use during the whole day, while two people out of the 228 students surveyed use the Internet for 24 hours. The modal value (mode that occurs most often) is equal to 6 hours, which means that most of the students use the Internet for 6 hours daily, which is completely consistent with the sample mean value (6,108) as indicated in the table 27 below:

Table 27. Descriptive Statistics of Number of Hours Spent on the Internet per Day

.

	N	Minimum	Maximum	Mean	Std. Dev.
I spend approximately on the Internet	226	,5	24,0	6,108	3,7468
Valid N (listwise)	226				

3.1.2.3. Computer Usage

Table 28. *Distribution of Frequency and Percentage for Respondents' Computer Use*

I Normally Use a Computer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	,4	,4	,4
	Very rarely, if ever	18	7,9	8,0	8,4
	Occasionally	36	15,8	15,9	24,3
	A few times a week	89	39,0	39,4	63,7
	Every day, I am addicted!	82	36,0	36,3	100,0
	Total	226	99,1	100,0	
Missing	System	2	,9		
Total		228	100,0		

As table 28 shows, 89 from the 228 respondents use their computers a few times a week, which represent 39% while 82 participants are addicted to computers and use them every day with a percent of 36%. Moreover, 15.8% (N=36) of the surveyed students use the computer occasionally during the week, while the other respondents (7.9%, N=18) use it very rarely, and eventually 0.4% never use the computer with a total number of only one participant.

3.1.2.4. Years of Using the Computer

Table 29. *Descriptive Statistics of Number of Years for Using the Computer*

.

I've Been Using a Computer for Approximately

Valid N	225
Missing	3
Mean	9,59
Median	10,00
Std. Deviation	3,523
Range	17
Minimum	1
Maximum	18

In order to gain clear insight into students' use of technologies, we asked them to report to us how long they have been using the computers. The average of their answers as presented in the table 29 above was 9.59 years (mean value), given that 92, 5% of the sample belongs to an age group category between 17 and 25 years old, with a percentage that varies between 38.36% and 56.41% of their lives.

3.1.2.5.Access to the Internet Connection

Table 30. *The Frequency of Access to Internet Connection*

		Responses		Percentage of Cases
		N	Percentage	
Access to Internet connection[a]	I have access to Internet connection at "Home/Student residence"	180	73,8%	81,4%
	I have access to Internet connection at "University/College/Learning center"	24	9,8%	10,9%
	I have access to Internet connection at "Other location"	40	16,4%	18,1%
Total		244	100,0%	110,4%

The participants were also asked to identify the place from which they have access to Internet Connection. As table 30 presents, 81.4% of the respondents (N=180) have access to the Internet at their place of residence, 18.1% (N=40) at other locations such as cafés or co-working spaces, whereas only 10, 9% of the students (N=24) claimed to have access to Internet connection at their institutions.

The elements of owning and using a computer along with the Internet access are of considerable significance in defining the key factors in adopting e-learning in education. In reality, we cannot refer to the implementation of e-learning in higher education without examining the level of learners' experience with technology tools and their comfort with technology.

The descriptive data analysis is of paramount significance so as to envision the various elements in the study; all variables are significant since they absolutely lead to some changes in the process of data analysis. Whereas the analytic side of the data can reveal the invisible elements in the research study.

3.1.3. Students' Digital Skills

The third set of questions in the questionnaire was designed to explore students 'use of digital tools in their everyday life. Therefore, the first research question of the present study examines the different digital skills and e-learning tools that students possess and benefit from.

- **RQ1**: What type of information and communication technologies (ICTs) do the students possess and benefit from?

To answer this question, participants were first asked to talk about their comfort level with technology, whether they consider themselves as technology experts, and the degree of their use of some online tools.

3.1.3.1. Comfort Level with Technology

Table 31. *Students' Comfort with Technology-Frequency (Percentages)*

.

Are You Comfortable with Technology?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	194	85,1	97,0	97,0
	No	6	2,6	3,0	100,0
	Total	200	87,7	100,0	
Missing	System	28	12,3		
Total		228	100,0		

As table 31 indicates, 97% of the respondents (N=194) feel comfortable with technology while only 3% (N=6) claim the opposite. On the other hand, we notice from the figure 12 below that 76.7% of the respondents sometimes consider themselves technology savvy with a total number of 168 participants, 15.5% (N= 34) qualify themselves as experts, and 7.8% (N=17) of the sample population do not consider themselves as technology savvy.

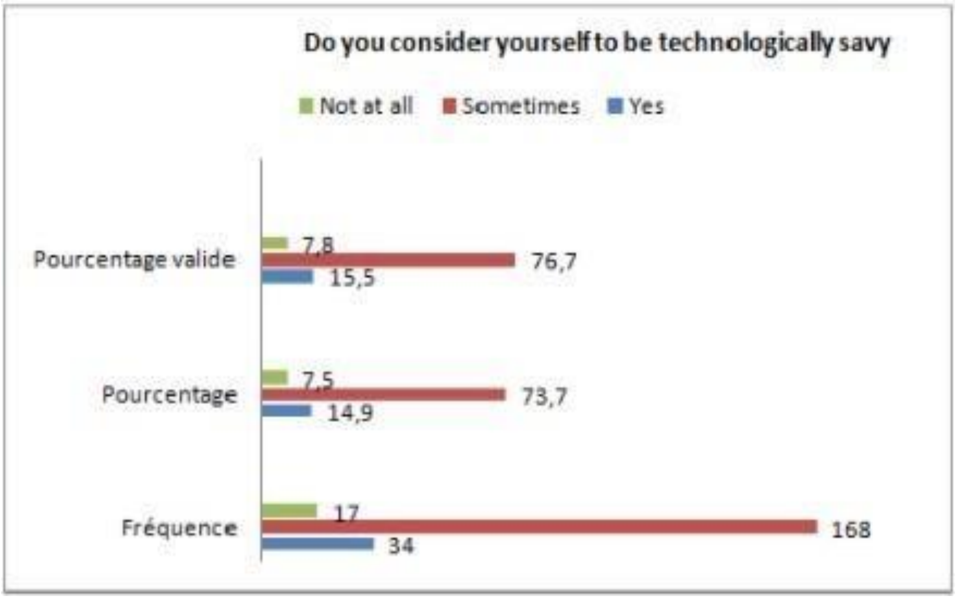


Figure 12. *Students' Experience with Technology*

3.1.3.2. Use of Digital Tools

Table 32. *Frequency and Percentage for Respondents Use of Social Networks*

I Use Social Networks

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Every day	199	87,7	87,7	87,7
	A few times a week	16	6,7	6,7	94,4
	Occasionally	12	5,3	5,3	99,7
	Rarely/Never	1	,4	,4	100,0
	Total	227	100,0	100,0	

Respondents were asked to report the degree of their use of social networks. As indicated in the table 32, 199 participants use their social networks on daily basis representing87.7% of the sample studied. On the other hand, 6.7% and 5.3% of participants use social websites a few times a week and occasionally respectively. However, only 0.4% claimed that they rarely or never use social media with a total number of 1 participant.

Table 33. *Frequency and Percentage for Respondents Use of Online Sites* or Virtual Worlds

I Use virtual Worlds or Online Sites

		Frequency	Percentage	Valid Percent	Cumulative Percentage
Valid	Yes	152	66,7	68,7	68,7
	No	70	30,7	31,3	100,0
	Total	222	97,4	100,0	
Missing	System	6	2,6		
Total		228	100,0		

From the table 33 we can see that 68.7% of the respondents (N=152) use online sites or virtual worlds while 70 participants claim the opposite; they represent 31.3% of the sample studied.

At this stage, the researcher wants to investigate the relationship between students' use of some online tools namely the use of online websites or virtual worlds and their frequency of computer use. In order to answer this question, she cross-tabulated the two variables.

Table 34. *Correlation between Using the Computer and the Use of Online Sites*

I normally use a computer * I use virtual worlds or Online Sites Cross-tabulation

		I use virtual worlds or online sites		
		Yes	No	Total
I normally use a computer	Never	0	1	1
	Very rarely, if ever	0	18	18
	Occasionally	34	2	36
	A few times a week	52	34	86
	Every day, I am addicted!	66	15	81
Total		152	70	222

As displayed in the table 34, we notice that as much as the respondents use their computers as much as they use online sites. For instance, respondents who answered "yes" to "using online sites" (N=66) are the same who claimed that they are addicted to using their computers. As a second step, in order to determine the degree to which both variables associate or covary, it was necessary to use the Chi-square test since we deal with qualitative variables. The Chi Square statistic is a non-parametric tool commonly used for testing relationships between categorical variables. A relationship is said to be positive when the sig value is lower than 0.005 (Creswell, 2009). As indicated in table 35 below, the significance of the test is equal to 0.000 which is much lower than 0.005, confirming the existence of a mutual influence between the two variables, namely the use of online websites and the use of computers.

Table 35. *Results of Chi-square Test*: The Association between the *Use of Computers variable and the Use of Online Websites variable*

Chi-square Tests

	Value	Df	Assymp. Sig. (2-sided)
Pearson Chi-square	60,964[a]	4	,000
Likelihood Ratio	67,894	4	,000
Linear-by Linear-Association	17,776	1	,000
N of Valid Cases	221		

a. 2 cells (20, 0%) have expected count less than 5. The minimum expected count is less than ,32.

In order to complete our investigation, we also wanted to verify the degree of this influence. We therefore used Cramer's *V* coefficient, which allows us to evaluate the relationship between the two variables in which the relationship is said to be strong when the coefficient is equal or superior to 0.70. In our case, the table 36 below indicates that Cramer's *V* coefficient is equal to 0.675 with a *p*-value of .000, which means that there exist a moderate positive association between the two variables. In other words, utilizing the computer and enhancing the digital skills supports to the use of online sites, as the use of online websites strengthens the digital skills of the students. Hemmi et al. (2009); Rutherford & Prytherch (2016) claim that "learners require skills of 'technoliteracy' in order to develop effectively as learners; without this the learners will not be able to utilize the full extent of technologies they are exposed to" (p.125). The main challenge here, therefore, is to grasp the potential of technology in order to be able to use it in learning.

Table 36. *Measures of Association between the Use of Computers and Use of Online Websites variables*

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,675	,000

Cramer's V	,675	,000
N of Valid Cases	221	

3.1.4. ICT and E-learning Use in Learning Engineering

As mentioned in the review of the literature, e-learning enjoys a very important status; it is implemented in curricula, employed in various domains, and practiced in numerous countries like United States, China, India, Jordan, Libya, Kenya and many other countries. Nevertheless, it is still poorly implemented in Morocco. In this paper, therefore, the purpose is to investigate and evaluate the extent to which e-learning is manifested in Moroccan higher education settings. Thus, the second research question investigates the degree of the students' use of e-learning tools for learning engineering.

- RQ2: Do Students use ICT and particularly e-learning in learning engineering?

3.1.4.1. Use of E-Learning Tools in Learning Engineering

Respondents were requested to identify the different digital tools they use for educational purposes, whether they have ever heard of an e-learning teaching program and whether they need further training to effectively use technology in learning.

The table below lists five different dimensions likely to answer the research question; on the one hand depicting students' use of synchronous chat tools (e.g. instant messaging, chat rooms), messaging and discussion tools (e.g. emails, phone texting), online websites or virtual words for education purposes. On the other hand, revealing students' familiarity with the concept of e-learning and the training they need to support the use of technology in engineering education. At this stage, the researcher wants to examine the relationship between students' use of these online tools and their familiarity with the concept of e-learning. In order to answer this question, she cross-tabulated the five variables

Table 37. *Relation and Degree of Association between Multiple Variables*

Dimension: 1 **Correlations**

	I use synchr -onous chat tools for educational purposes	I use messaging &discussio n- tools for educ purpos	I use online or virtual sites for educational purposes	Have you ever heard about an e-learning program?	Do you need further training?
Iuse synchronous chat tools (E.g. instant messaging, chat room, IP technology) for educational purpose[a]	1,000	,344	-,003	,210	,095
I use messaging and discussion tools for educational purpose (E.g. Email, Forums, Phone texting)[a]	,344	1,000	,071	,320	,006
I use virtual worlds or online sites for educational purposes[a]	-,003	,071	1,000	,052	-,141
Have you ever heard about an e-learning teaching program[a]	,210	,320	,052	1,000	,118
Do you need further training[a]	,095	,006	-,141	,118	1,000
Dimension	1	2	3	4	5
Proper Value	1,613	1,153	,865	,765	,603

a. Group

As indicated in table 37, the two main relationships are between using synchronous chat tools and using messaging and discussion groups for education purposes with a coefficient value of 0.344. Whereas the second relationship relates the use of discussion groups for educational purposes with students' familiarity with e-learning with a *p* value equal to 0.320. However, we can notice that the coefficient value of these associations is around 30% (32% and 34%) which means that the influence is not as strong between the variables examined. Actually, the only positive relationships as indicated in the table reflect the mutual influence ofthe variables on themselves (*p*=1, 000).

The following table is first used to ensure that the variables selected by the researcher have actually an explanatory role of the research construct (the use of ICT and e-learning in education). On the other hand, it allows reducing the number of variables studied into two main dimensions; each one contains a group of homogeneous variables. In this case, the five dimensions previously mentioned have been reduced to two main dimensions. The first dimension explains 50.2% of the research construct while the second one only explains 22.9% as displayed in the table below:

Table 38. *Cronbach's Alpha of Value Dimensions*

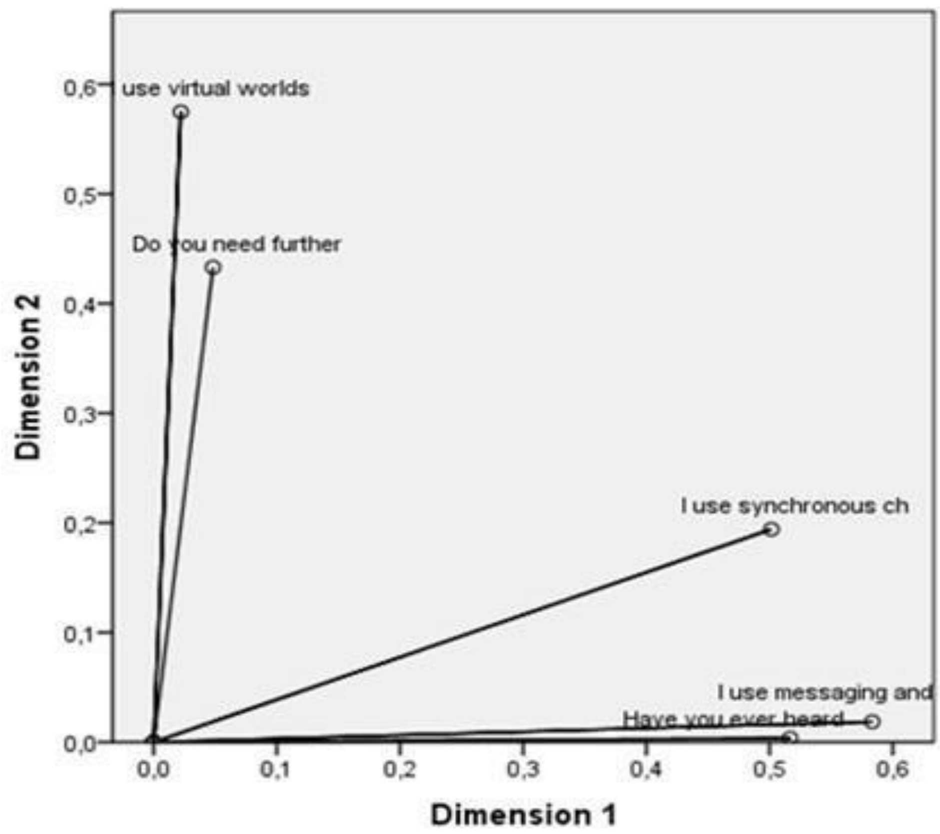
Model Summary

Dimension	Cronbach's Alpha	Explained Variance	
		Total (Eigenvalue)	Inertia
1	,502	1,672	,334
2	,229	1,224	,245
Total		2,896	,579
Mean	,387[a]	1,448	,290

a. The Average Cronbach's Alpha value is based on the average eigenvalue.

At this stage, and after confirming a Cronbach alpha of 50, 2% and 22, 9% respectively, the researcher still has to identify these so-called main dimensions. In order to meet this need, she resorts to discrimination measures (see map 13). The first dimension is related to the use of messaging and discussion tools alongside the use of synchronous chat tools for educational purposes, while the second one is related to the use of virtual words and online websites.

Discrimination Measures



Variable Principal Normalization

Figure 13. *Perceptual Map Resulting from Multiple Correspondene Analysis (MCA)*

To conclude, students mainly use two main categories of ICT tools in their learning. The most important one is dimension 1. That is to say, the most used ICT tools are the ones related to messaging tools and synchronous chat tools, followed by the second dimension, which is related to the use of virtual worlds or online sites.

3.1.5. Students' Digital Skill Level

At this level, the researcher wants to examine the skill level of engineering students in making meaningful use of digital tools in learning. Therefore, the third research question investigates how skilled are engineering students in using ICT and e-learning for learning purposes.

- RQ 3: How skilled are the learners in using e-learning?

To answer this question, participants were first requested to talk about their ability to use e-learning platforms, and whether they need further trainings to develop their digital skills.

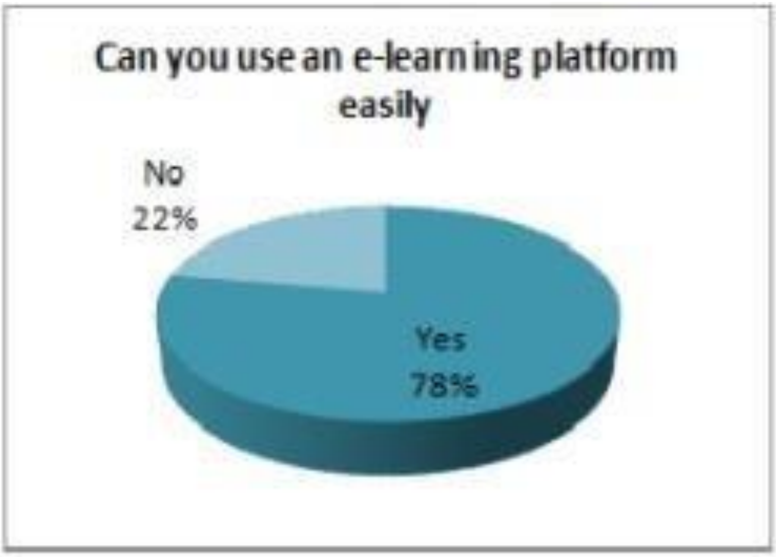


Figure 14. *Distribution of Percentage for Respondents' Ability to Use E-Learning Platforms*

Regarding the participants' ability to use an e-learning platform, the figure shows that 78% (N=178) of the respondents consider themselves capable of using such a platform; they represent the majority, while only 22% (N=50) claimed not to be able to use it. Those results clearly explain the data presented in the figure 15 below in which the majority (75%, N= 171) of respondents do not think they need a specific training while 25% of participants (N=57) expressed their need for further training programs to be able to use e-learning platforms.

Figure 15. *Distribution of Percentage for Respondents' Need for further Training*

The purpose of this research question is to determine students' level of digital skills; therefore, the research construct is students' digital skills while the explanatory variables are their level of technology knowledge, their ability to use an e-learning platform, and their need for specific training programs. The next step seeks to determine the relationship between those variables; accordingly, the table 39 provides a multivariate analysis of the different existing correlations.

Table 39. *Correlation between Various Variables*

Dimension: 1 **Correlations**

	Do you consider yourself as technology savvy	Can you use an e-learning platform easily	Do you need further trainings
Do you consider yourself as technology savvy[a]	1,000	,225	,116
Can you use an e-learning platform easily[a]	,225	1,000	,114
Do you need further trainings[a]	,116	,114	1,000
Dimension	1	2	3
Eigenvalue	1,310	,915	,775

a. Dichotomy group tabulated at value 1

As displayed in the table 39 above, the correlations between the three variables studied are not strongly significant, with a coefficient magnitude that varies between 11, 4% and 22, 5% (0, 225 & 0, 114) which does not necessarily mean a presence of an independent association between them.

3.1.6. The Impact of Students' Background Variables on their Computing Skills and Use

This section attempts to examine the potential differences among participants regarding their use of e-learning technology. The fourth research question, therefore, investigates the impact of learners' background variables (gender, age, level of education, institution…) on their e-learning technology use and skills.

- RQ 4: How do students' variables (sex, age, level of education, type of school) pertain to e-learning use and competencies?

To answer this question, the researcher first investigated the impact of respondents' variables on the amount of time they spend on the Internet.

3.1.6.1. Impact of Respondents' Background Variables on the Time Spent on the Internet

- **Impact of Respondents' Gender**

Table 40. *Descriptive Statistics for Time Spent on the Internet according to Gender*

Descriptive Statistics

I spend approximately on the internet

	N	Mean	St. Dev.	St. Error	95 % confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
Male	131	6,103	3,6547	,3193	5,471	6,735	,5	24,0
Female	94	5,989	3,7092	,3826	5,230	6,749	1,0	24,0
Total	225	6,056	3,6697	,2446	5,573	6,538	,5	24,0

The table 40 above presents the descriptive statistics of the hours students spend on the internet according to gender. It is noticed that female students spend an average of 5.9 hours on the Internet per day ($\simeq$ 6 h/d), while male students spend an average of 6.1 hours per day, a difference of only 0.2 hours between male and female students (see curve, below).

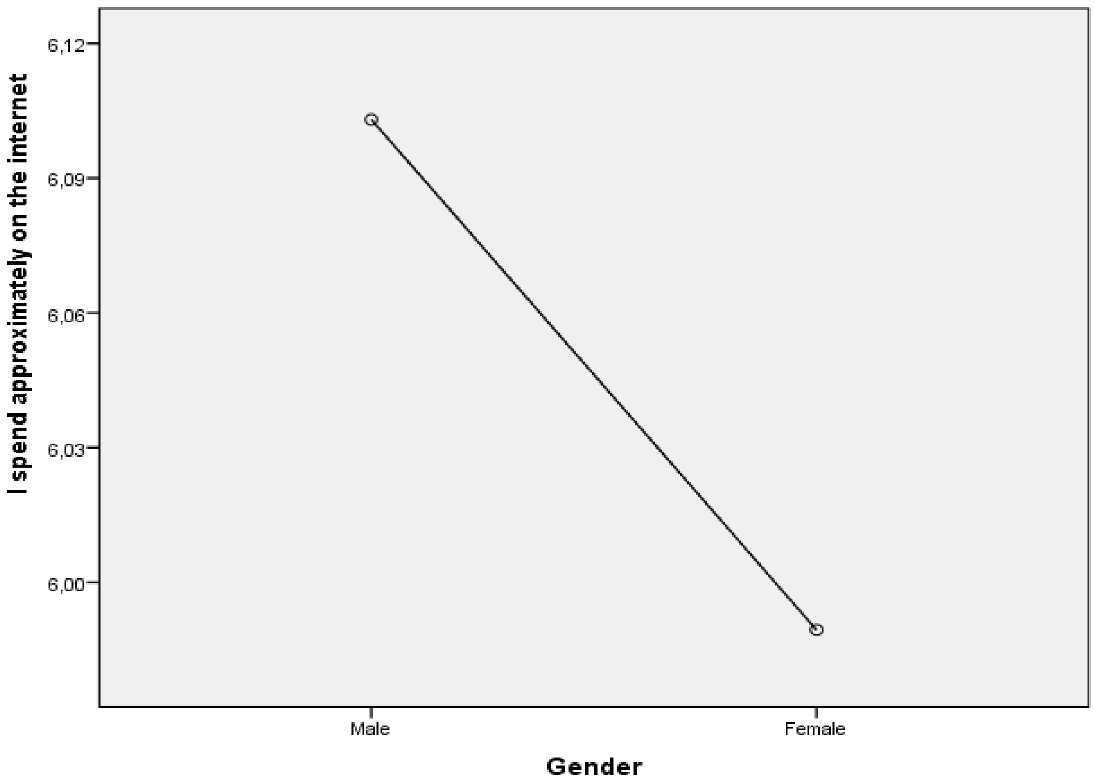


Figure 16. *Amount of Time Spent on the Internet according to Gender*

The results of the descriptive statistics prompt us to search for an association between the two variables examined, gender and the number of hours spent on the Internet. To do this, the analysis of variance (ANOVA) between a quantitative dependent variable (number of hours) and an independent qualitative variable (gender) was used. The ANOVA test is a statistical tool that compares the means of groups of data sets and to what extent they differ.

Table 41. *Analysis of Variance-Gender*

ANOVA

I spend approximately on the Internet

	Sum of Squares	Df	Mean Squares	F	Sig.
Between groups	,707	1	,707	,052	,819
Within groups	3015,848	223	13,524		
Total	3016,556	224			

While dealing with an ANOVA test, it can be said that an influential relationship exists, if only the level of significance is lower than 5%. In the case of this study, the level of significance is equal to 81, 9%, which is much higher than the norm. We can conclude then that the gender variable has no influence on the number of hours spent on the Internet by the students. That is, the number of hours spent on the Internet does not depend on gender of the respondents.

- **Impact of Respondents' Age**

If the students' gender does not influence the number of hours spent on the Internet, the researcher would like to check if an influential relationship exists between the time spent on the Internet and age of the respondents. She then proceeds in the same way; first, she compares the descriptive statistics according to the age group and then opts for an ANOVA test as a second step.

Table 42. *Descriptive Statistics for Time Spent on the Internet according to Age*

Descriptive Statistics

I spend approximately on the internet

	N	Mean	St. Dev.	St. Error	95% Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
[17-25]	209	5,935	3,7258	,2577	5,427	6,443	,5	24,0
[26-35]	17	8,235	3,4284	,8315	6,473	9,998	3,0	11,5
Total	226	6,108	3,7468	,2492	5,617	6,600	,5	24,0

It is important to mention that all of the participants involved in this survey belong to only two age groups. 92.5% of the sample are between the ages of 17 and 25 years old while only 7.5% of them are between the ages of 26 and 35. If we consider the values shown in the table above, we notice that participants who belong to the first age category use the Internet almost 6h per day, while respondents aged 26-35 years spend 8.2h/d of their time on the Internet; a difference of 2.3h per day.

The difference is much more important than the one obtained between males and females. To have a more precise idea on the level of influence of the age group on the number of hours spent on the Internet, the ANOVA test was used since we wish to carry out an analysis of variance between a dependent quantitative variable (number of hours spent on the Internet) and an independent ordinal qualitative variable (age).

Table 43. *Analysis of Variance-Age*

ANOVA

I spend approximately on the Internet

	Sum of Squares	Df	Mean Squares	F	Sig.
Between Groups	83,157	1	83,157	6,057	,015
Within Groups	3075,437	224	13,730		
Total	3158,594	225			

From the table 43 above, we get an ANOVA test with a significance value of 1.5%, which is much lower than 5%. In this case, we can confirm that the "age" variable influences the number of hours students spend on the Internet. In other words, the time spent on the Internet during the students' day depends on their age. According to the figure 17, older students spend more time than others do with a difference of more than two hours per day.

I Spend Approximately on the Internet

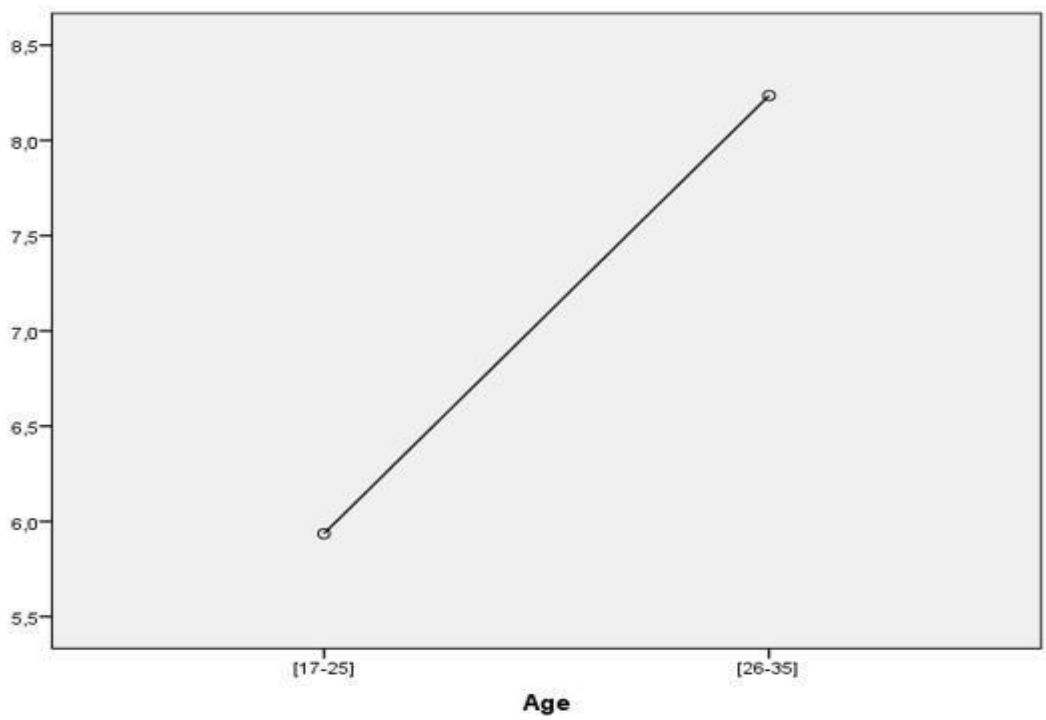


Figure 17. *Amount of Time Spent on the Internet according to Age*

- **Impact of Respondents' Frequency of the Computer Use**

After studying the gender and the age variable, this study attempts to test the relationship between the number of hours spent on the Internet and the respondents' frequency of computer use. The following table presents the descriptive statistics of the hours students spend on the internet according the frequency of computer usage.

Table 44. *Summary Statistics for Time Spent on the Internet in Relation to the Frequency of Computer Use*

Descriptive Statistics

I spend approximately on the internet

	N	Mean	St. Dev.	St. Error	95 % Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
Never	1	1,500	.	.	.	.	1,5	1,5
Very rarely, if ever	18	3,000	,6860	,1617	2,659	3,341	1,0	5,0
Occasionally	35	7,714	3,8315	,6476	6,398	9,030	1,0	11,0
A few times a week	88	6,636	4,0091	,4274	5,787	7,486	,5	24,0
Every day, I'm addicted !	82	5,610	3,3509	,3700	4,873	6,346	1,0	24,0
Total	224	6,114	3,7556	,2509	5,619	6,608	,5	24,0

Table 44 shows that the average number of hours spent on the Internet is 6.11h per day. Comparing this average to that of each frequency of computer use, we see that the average hours are very low for the lowest frequencies (e.g. Never=1.5h/d), while they start to approachthe general average when the frequencies of computer use become more important (e.g. Occasionally= 7.7h/d).

To get a little clearer idea of the relationship between these two variables the researcher used the ANOVA test, which according to the table below, indicates a significance value of 0.00. Thus, based on the interpretation standards, the influence relationship between these two variables is highly significant.

Table 45. *Results of Analysis of Variance (ANOVA)*

ANOVA

I spend approximately on the Internet

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	330,328	4	82,582	6,425	,000
Within Groups	2815,019	219	12,854		
Total	3145,347	223			

According to the figure 18 below, the number of hours students spend on the Internet strongly depends on how often they use the computer. Fluctuations in the curve confirm this strong relationship of influence, which increases dramatically as frequencies increase. The curve takes its higher value with the frequency "Occasionally" where we see the inflection point, so that the average hour begins to drop. However, the last two average always remain close to the general average. In other words, the decrease of the average after the fluctuation point is not very significant compared to the average of the first frequency (Never). In other words, the more the respondents use their computers, the more they spend more time on the Internet.

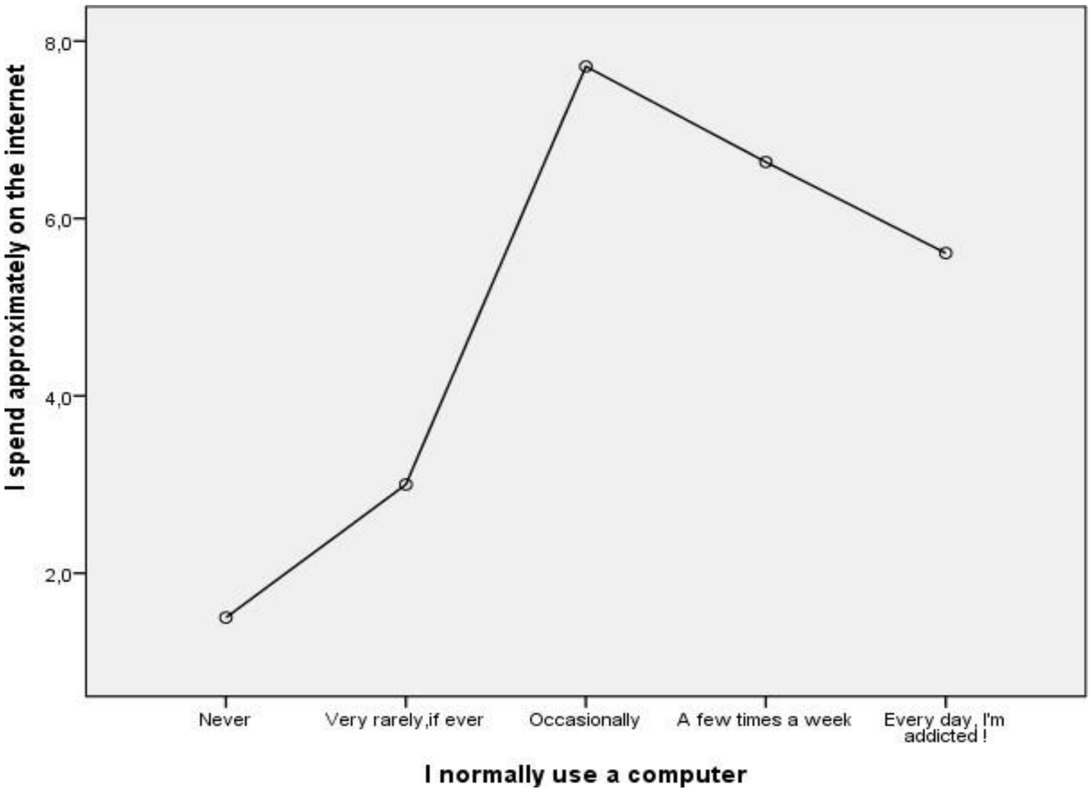


Figure 18. *Amount of Time Spent on the Internet in Relation to the Frequency of Computer Use*

To conclude the first part of this research question, we confirm two hypotheses. The first hypothesis is the one that proves the relationship between the number of hours devoted to the students' daily use of the Internet and their age and a second one that assumes the influence of the frequency of computer use on the time spent on the Internet. On the other hand, there is no influential relationship between students' gender and the number of hours spent on the Internet. In other words, the hypothesis that suggests that the number of hours spent by students on the Internet changes according to their gender is clearly invalidated.

3.1.6.2. Impact of Respondent's Background Variables on the Use of E- learning Tools

- **Impact of Gender**

At this level, the researcher wants to see the impact of the gender variable on the use of e-learning tools by students. She therefore carried out a multivariate analysis combining the three variables relating to the use of e-learning tools for educational purposes (I use synchronous chat tools/I use messaging and discussion tools/ I use virtual worlds or online sites for educational purposes) and the gender variable. According to the table 46 below the number of students who answered these three questions is 128 male students compared to 95 female students. We can first see that the number of female students who use digital tools for learning purposes is somewhat less than the number of male students.

Table 46. *Correlation between E-learning Use and Gender*

E-learning use * Gender Cross-tabulation

			Gender		
			Male	Female	Total
E-learning use[a]	I use synchronous chat tools (E.g. instant messaging, chat room, IP telephony) for educational purposes	Count	118	90	208
	I use messaging and discussion tools for educational purposes (E.g. Email, Forums, Phone texting)	Count	115	85	200
	I use virtual worlds or online sites for educational purposes	Count	85	66	151
Total		Count	128	95	223

On the other hand, the figure 19 shows us the distribution of the participants' answers to the different questions according to their sex. Based on these results, we notice that the male students are the ones who mostly use the different digital tools for educational purposes. We can therefore conclude that the gender of the students influences to some extent the use of digital tools for education purposes.

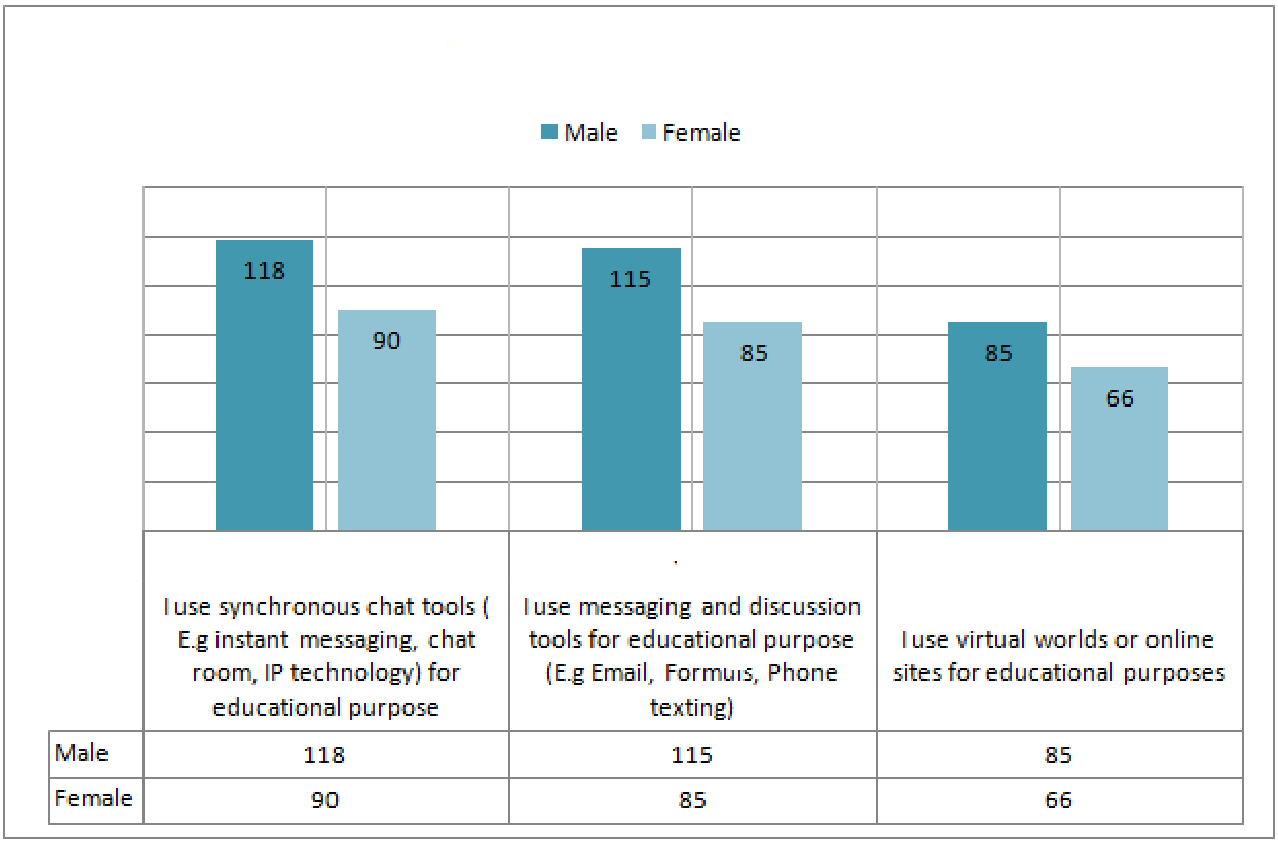


Figure 19. *Grouped Data Histogram for E-Learning Use and Gender*

- **Impact of Age**

After the gender variable, we are now interested in the age variable and its relationship with the use of digital tools for learning purposes. According to the table 47 below, we first notice that there are only two age categories: the first age group from 17 to 25 years old represents 207 answers and the second age group from 26 to 35 years old constitutes 17 answers, that is to say 92.4% and 7.6% of the sample, respectively.

Table 47. *Correlation between E-Learning Use and Age*

.

E-learning Use * Age Cross-tabulation

			Age		Total
			[17-25]	[26-35]	
E-learning use[a]	I use synchronous chat tools (E.g. instant messaging, chat room, IP telephony) for educational purposes	Count	191	17	208
	I use messaging and discussion tools for educational purposes (E.g. Email, Forums, Phone texting)	Count	184	17	201
	I use virtual worlds or online sites for educational purposes	Count	141	11	152
Total		Count	207	17	224

a. Dichotomy Group Tabulated at value 1

For a more detailed reading of the data, the histogram below was used to provide a clearer and more complete picture of the results. Thus, we notice that the youngest students [17-25] are the ones who use the different digital tools the most. Moreover, we notice that synchronous chat tools and instant messaging tools are the digital tools mostly used by students in both categories. We can therefore conclude that the age of the students influences the use of digital tools for education purposes.

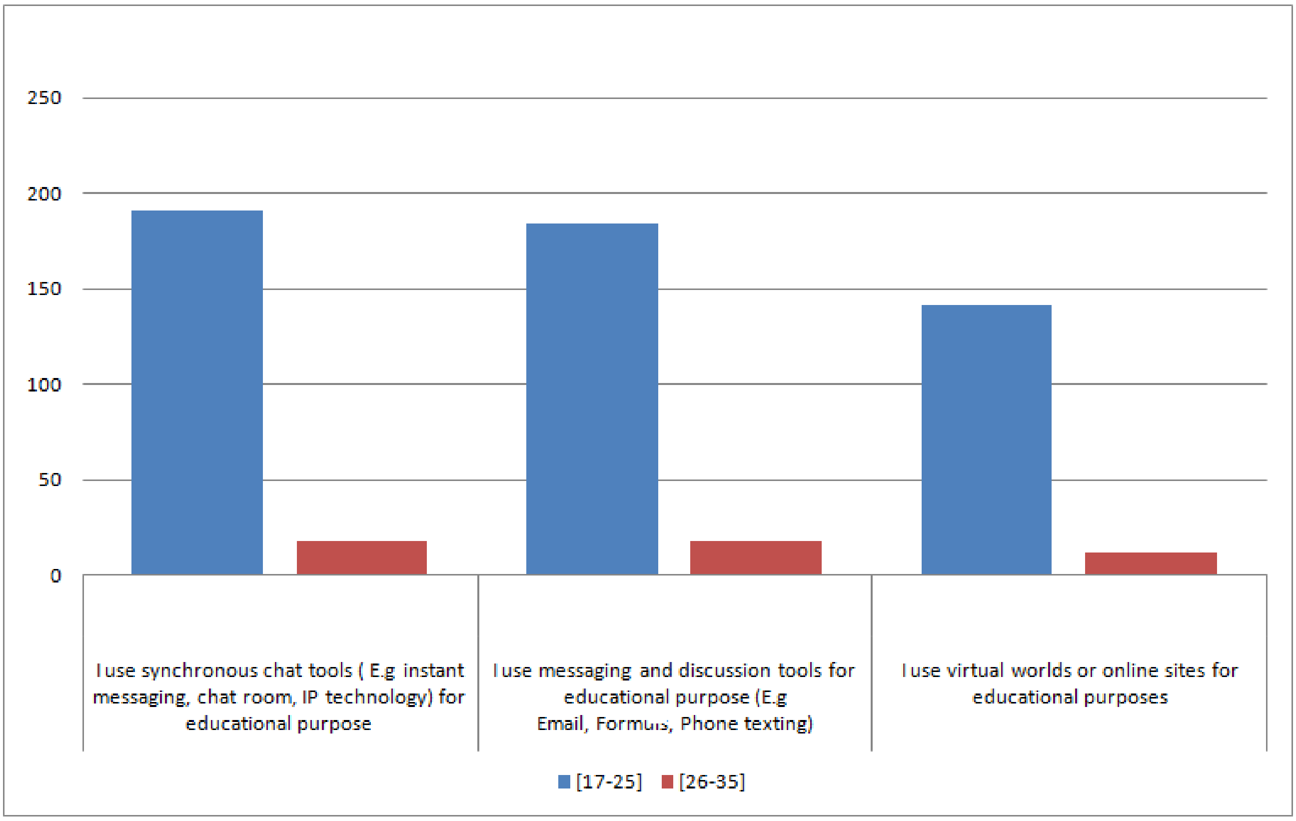


Figure 20. *Grouped Data Histogram for E-Learning Use and Age*

- **Impact of Public/Private Sector on the Use of Online Tools**

Still within the framework of the use of digital tools for educational purposes, the researcher wishes to make a comparison between students' use of these tools according to the private/public sector of their institutions. To do this, the answers to the three questions (I use synchronous chat tools, I use messaging tools, I use virtual words) were crossed with the answers of the students of the public School (ENSA) and those of the private School (EMSI).

The table 48 below shows us that the figures are very close between the two sectors; 114 students from the ENSA School answered all the questions related to the use of digital toolsfor educational purposes, and 110 students from the EMSI School confirmed their use of thesetools for the same reason. It can be therefore concluded that the private/public sector in itself does not influence the use of digital tools used by students for learning engineering.

Table 48. *Correlation between E-Learning Use and Type of the Institution*

.

E-learning Use * University-Institution Cross-tabulation

			University/Institution		
			ENSA	EMSI	Total
E-learning use[a]	I use synchronous chat tools (E.g. instant messaging, chat room, IP telephony) for educational purpose	Count	99	109	208
	I use messaging and discussion tools for educational purpose (E.g. Email, Forums, Phone texting)	Count	91	110	201
	I use virtual worlds or online sites for educational purposes	Count	79	73	152
Total		Count	114	110	224

a. Dichotomy group tabulated at value 1

As the case in the two previous relationships, it is noticed that the tools most preferred by students are those related to synchronous chat tools followed by messaging and discussion tools as presented graphically by the histogram below:

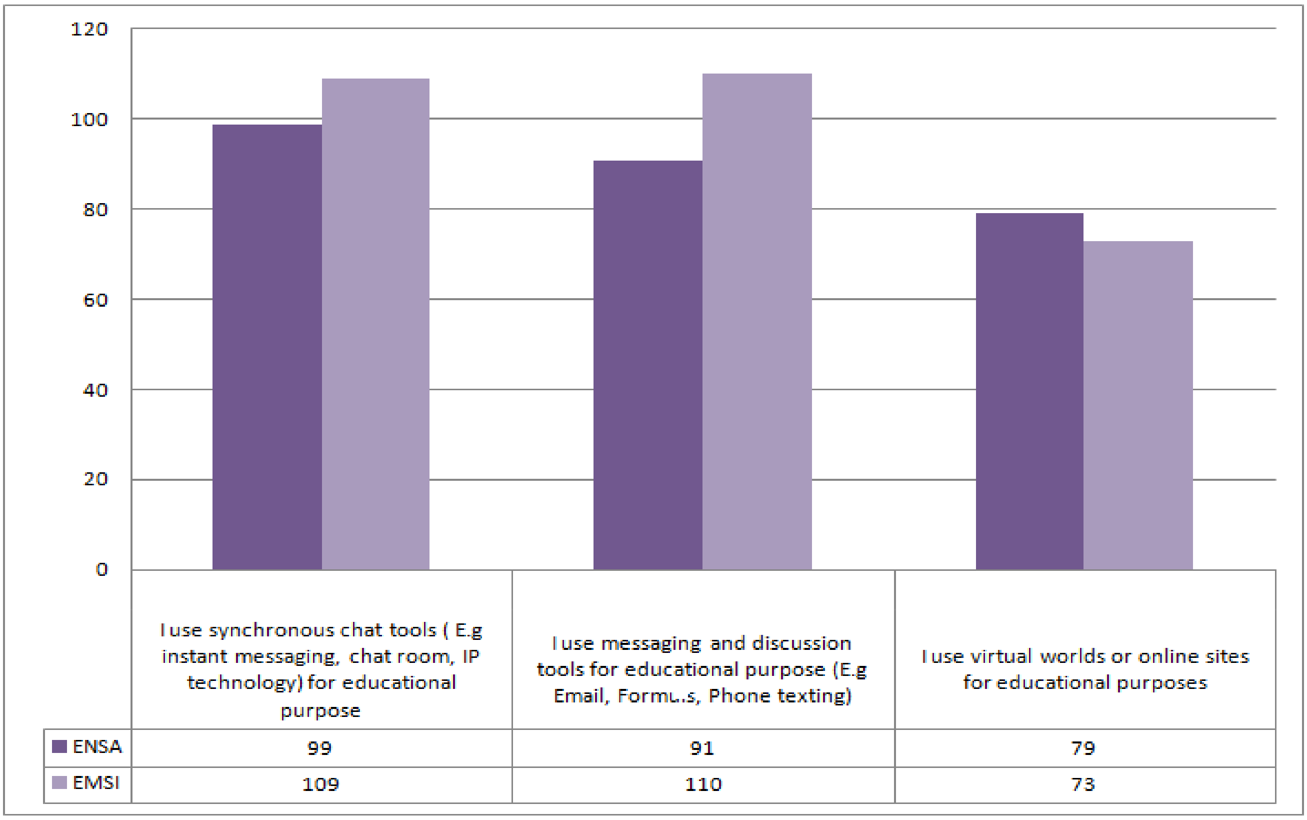


Figure 21. *Grouped Data Histogram for E-Learning Use and Private/Public Sector*

3.1.6.3. Impact of Respondents' Background Variables on their Enrollment in Online Courses

- **Impact of Respondents' Familiarity with E-learning Platforms**

At this stage of answering the fourth research question, the researcher is looking for the relationship of influence that may exist between students' familiarity with e-learning platforms and the number of online courses they are enrolled in, considering the fact that "students' familiarity" is the independent variable that influences the dependent variable "number of courses taken online". First, the participants were asked whether they have ever heard of an e-learning teaching program and the number of online courses they are registered in, the table 49 below introduces the descriptive statistics for the two variables.

Table 49. *Summary Statistics for Students' Familiarity with E-learning in Relation to Students' Enrollment in Online Courses*

Descriptive Statistics

How many Online courses are you registered in

	N	Mean	St. Dev.	St. Error	95 % Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
Yes	171	2,59	1,432	,110	1,74	2,18	1	6
No	41	1,66	1,658	,259	2,06	3,11	1	6
Total	212	2,08	1,495	,103	1,88	2,28	1	6

First, we notice that 171 participants are familiar with the concept of e-learning teaching programs; they represent the majority (80.6%), while only 41 participants (17.9%) claim the opposite. Second, the objective of the analysis of variance as previously discussed, is to verify the relationship of influence between the so-called dependent quantitative variable and independent qualitative variable. In the table 49 above, we compare the average number of online courses enrolled by students who are familiar with e-learning and that of students who are not. According to the same table, the first category benefited generally from more than two online courses (≃ 2.59) whereas the second category of students are enrolled in 1.66 online courses. By comparing these two figures with the general average of 2.08 courses, it can be stated that the question of familiarity influences the average of online learning courses enrolled by students. To have a more precise idea on the level of influence between these variables the ANOVA test was adopted.

Table 50. *Results of Analysis of Variance*

ANOVA

How many online courses are you registered in

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	12,972	1	12,972	5,939	,016
Within Groups	458,665	210	2,184		
Total	471,637	211			

The result of the ANOVA test indicates a significance of 0.016 (1.6% <5%). This means that an association do exist between students' familiarity with e-learning and the number of online courses they are registered in. In other words, the qualitative variable “students’ familiarity with e-learning” influences the quantitative variable “number of online courses enrolled by students”. That is to say, the students who are more familiar with e-learning programs subscribe to a larger number of online courses compared to the students who are less familiar with such programs as shown in the figure below. This can be explained by the fact that being familiar with e-learning is a factor that leads to students' enrollment in online classes.

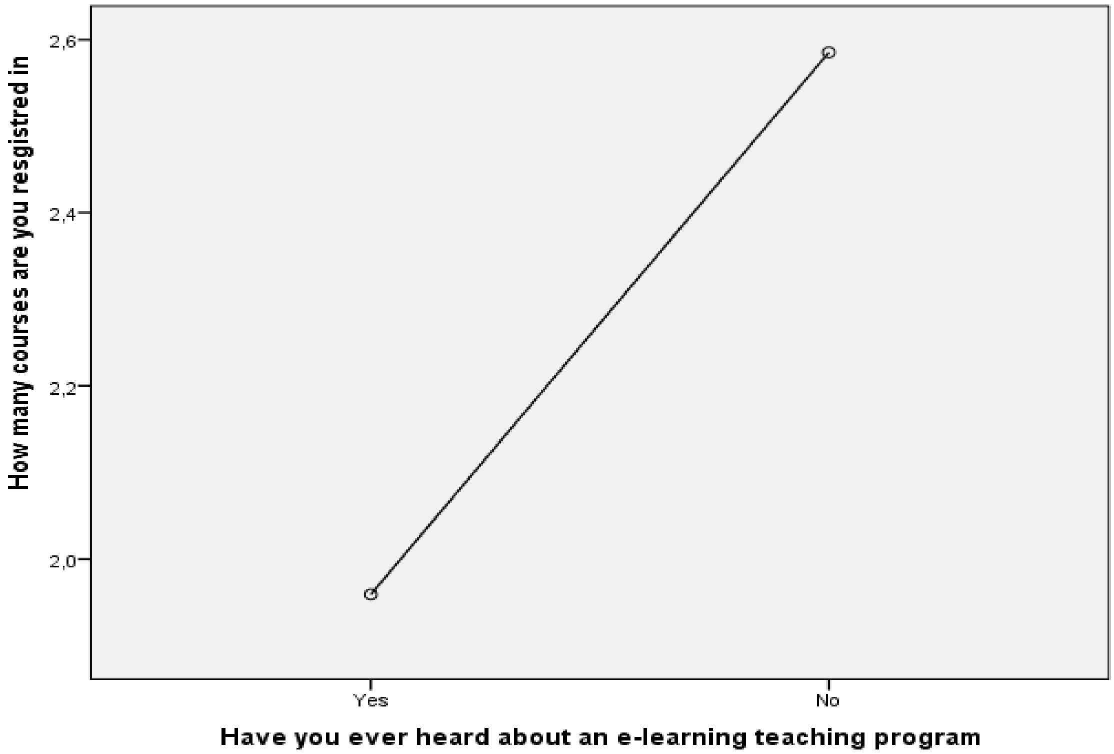


Figure 22. *Students' Familiarity with E-Learning in Relation to Students' Enrollment in Online Courses.*

- **Impact of Respondents' Ability to Use E-learning Platforms**

Another relationship that seems important to answer the fourth research question is the one that links the number of online courses enrolled by students, and their ability to use e-learning platforms effectively. In order to verify this potential relationship between the first independent quantitative variable and the second dependent nominal qualitative variable, ANOVA analysis was used.

Table 51. *Summary Statistics for Students' Proficiency in Using E-Learning Platforms in Relation to Students' Enrollment in Online Courses*

Descriptive Statistics

How many online courses are you registered in

	N	Mean	St. Dev.	St. Error	95 % Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
Yes	166	2,20	1,563	,121	1,97	2,44	1	6
No	43	1,56	1,053	,161	1,23	1,88	1	6
Total	209	2,07	1,493	,103	1,87	2,28	1	6

Table 51 represents the average of the online learning courses the students take based on their proficiency in using e-learning platforms. The average of those who answered yes is 2.20 and the average of those who answered no is 1.56. After comparing the two values with the total average that is equal to 2.07, we notice that the students who subscribe to more courses are themselves more competent in using e-learning platforms. This finding arouses our scientific curiosity, so we are going to deepen the analyses of variances to verify this probable relationship of influence between the number of online learning courses subscribed by the students and the ability to use e-learning platforms.

Table 52. *Results of the Analysis of Variance*

ANOVA

How many courses are you registered in

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	14,283	1	14,283	6,575	,011
Within Groups	449,641	207	2,172		
Total	463,923	208			

As mentioned earlier, a significance value of 1.1% (<< 5%) illustrated in the table above, is sufficient to confirm the relationship between the two variables in question. That is to say, the ability to use e-learning platforms more easily depends on the number of online courses students are enrolled in, and enrollment in online courses depends on the effective use of online platforms. In other words, the more students benefit from online classes, the more skills they develop to benefit from online learning platforms and vice versa. The figure below clearly shows us the degree of association between the variables. We see the curve representing the number of online courses taken by students goes down significantly from left to right, that is to say, students who have taken more online courses are those who master this type of programs.

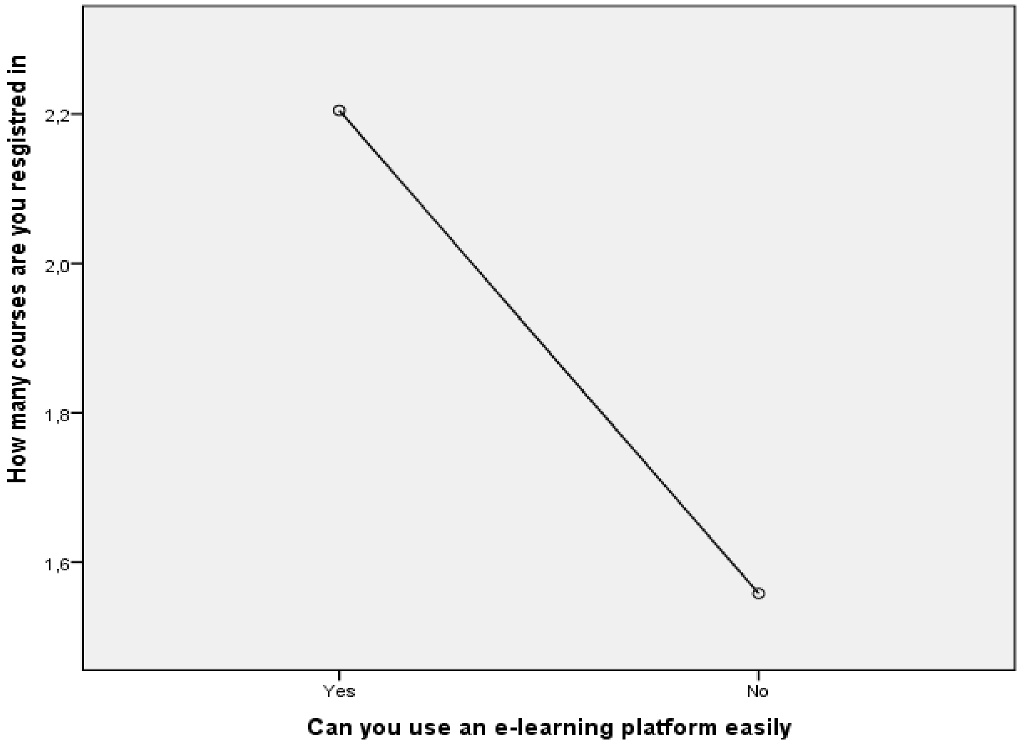


Figure 23. *Students' Ability to Use E-Learning Platforms in Relation to Students' Enrollment in Online Courses.*

- **Impact of Public/Private Sector on Respondents' Enrollment in Online courses**

Another question that seems very interesting in the context of the fourth research question is the one that involves the private/public sector of the institution as a variable influencing the number of online courses taken by students. According to the table 53 below, students who belong to the public sector are the ones who get subscribed the most to online courses with an average of 2.55, for only 1.7 as the average of courses subscribed by students belonging to the private sector. Therefore, an association between the two variables seems possible based on these initial results

Table 53. *Summary Statistics for Students' Place of Study in Relation to Students' Enrollment in Online Courses*

Descriptive Statistics

How many online courses are you registered in

	N	Mean	St. Dev.	St. Error	95 % Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
ENSA	107	2,55	1,706	,165	2,22	2,88	1	6
EMSI	109	1,70	1,167	,112	1,48	1,92	1	4
Total	216	2,12	1,517	,103	1,92	2,32	1	6

Table 54 confirms an existing relationship between the two variables. With a significance value equal to zero (p=0,000) we can deduce that the private/public sector of the institution influences the number of online courses taken by students. The figure below gives more explanation about this relationship in which the students belonging to ENSA School, which represents the public sector in our study use more e-learning platforms compared to the students belonging to the private sector represented by the EMSI School.

Table 54. *Results of the Analysis of Variance*

ANOVA

How many online courses are you registered in

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	39,394	1	39,394	18,509	,000
Within Groups	455,476	214	2,128		
Total	494,870	215			

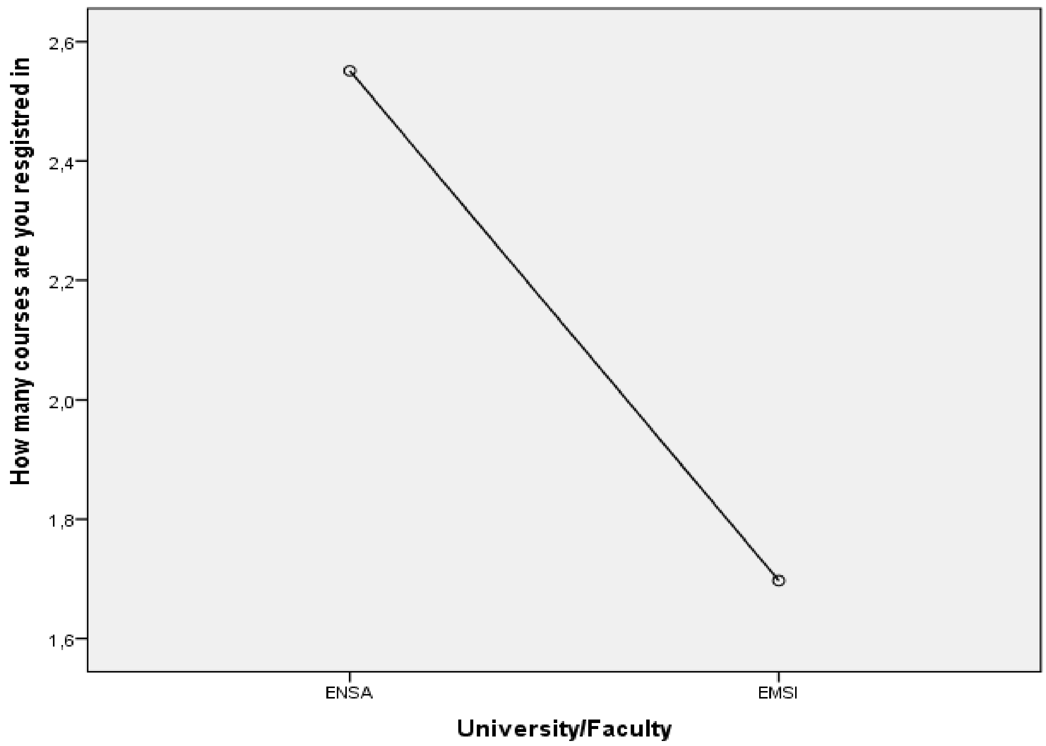


Figure 24. *Students' Place of Study in Relation to Students' Enrollment in Online Courses.*

- **Impact of the Educational Level on Enrollment in Online Courses**

The relationship detected between the private/public sector of the institution and the number of online courses subscribed by students inspired the researcher to search for another relationship that is somewhat similar, but which is rather related to the students' educational level. The table below shows us the average number of online courses taken by students at each education level ($1^{st,}$ 2^{nd}, and 3^{rd} year). Based on the findings, we can see that the average number of online courses taken by first-year students (2.81) is higher than the average for second year students (1.85) and third-year students (1.62). In order to confirm the presence of a dependency relationship between the two variables examined, the researcher used the analysis of variance method (ANOVA).

Table 55. *Summary Statistics for Students' Level of Education in Relation to Students' Enrollment in Online Courses*

Descriptive Statistics

How many Online courses are you registered in

	N	Mean	St. Dev.	St. Error	95 % Confidence Interval		Minimum	Maximum
					Lower Limit	Upper Limit		
First year	63	2,81	1,865	,235	2,34	3,28	1	6
Second year	137	1,85	1,258	,107	1,64	2,07	1	6
Third year	13	1,62	1,121	,311	,94	2,29	1	4
Total	213	2,12	1,518	,104	1,92	2,33	1	6

The ANOVA test gives us a significance rate that tends towards zero (see table 56 below) which confirms the existence of an influencing relationship between the educational level of students and the number of online courses to which they subscribe.

Table 56. *Results of the Analysis of Variance*

ANOVA

How many Online courses are you registered in

	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	42,955	2	21,477	10,116	,000
Within groups	445,872	210	2,123		
Total	488,826	212			

First year students benefit the most from online courses compared to second and third year students as illustrated in the figure below:

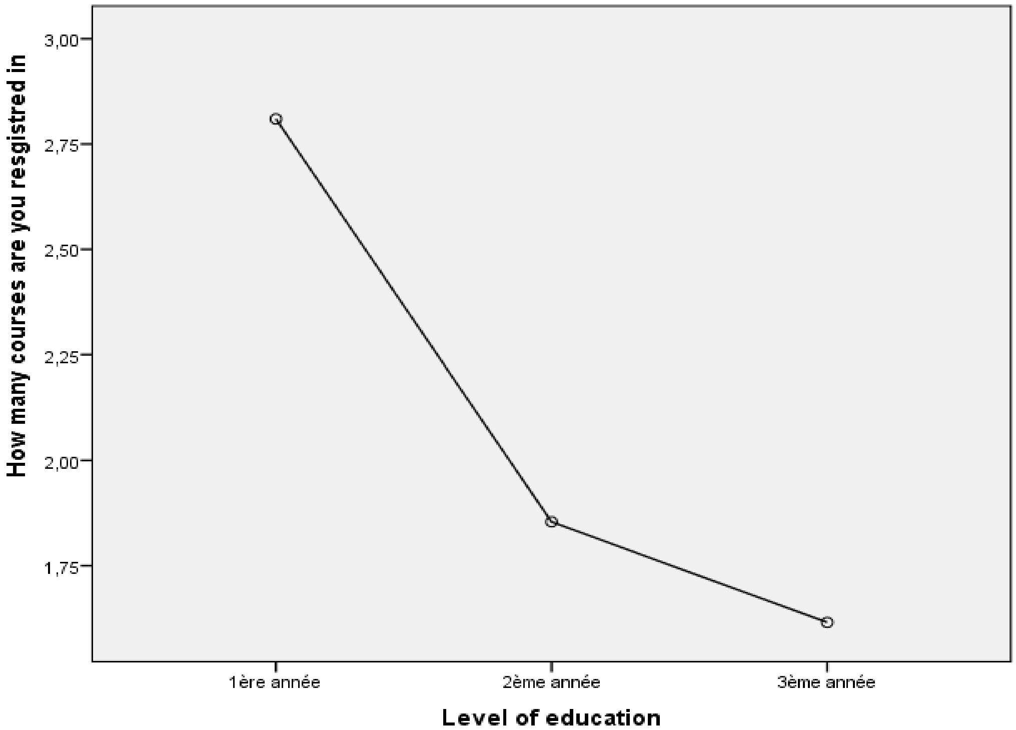


Figure 25. *Students' Level of Education in Relation to Students' Enrollment in Online Courses*

3.1.7. Students' Perceptions and Attitudes towards the Use of E-learning in Engineering Education

3.1.7.1. Students' Attitudes towards the Use of Technology in Class

As mentioned in the review of the literature, students tend to have positive attitudes towards technology for learning. Rhema & Miliszewska (2014) point out that "university students in developing countries have varying attitudes towards e-learning but generally their attitudes are positive" (p. 170). This section, thus, aims to answer the fifth research question that examines students' perceptions and attitudes towards the use of ICT and particularly e-learning in learning engineering.

- RQ5: How do college students perceive e-learning technology in learning higher engineering education?

In order to answer this question, respondents were first questioned about their attitudes towards using technology in class. At this level, the researcher cross-tabulated the two variables namely, are you for or against the use of technology and why.

Table 57. *Correlation between the Use of Technology in class and Why*

Are you for or against the use of technology in class * Why Cross-tabulation

	Are you for or against the use of technology in class?			Total
	For	Against	Neutral	
Why	79	8	32	119
Amusing	3	0	0	3
Constructive	13	0	1	14
Ease and accessibility	85	0	1	86
Necessity	2	0	0	2
Waste of time	0	4	0	4
Total	182	12	34	228

Table 57 shows that 182 from the 228 participants surveyed (79.82%) are for the use of technology in class in which 79 respondents did not specify the reason. For those who are neutral they constitute 14, 91% with a total number of 34 participants, while respondents who are against technology use in learning represent 0,05% with a total number of 12 participants. However, the most used argument by those who agree on the use of technology for education purposes is based on speed and ease of access to more resources.

Additionally, the researcher tries to verify the relationship between students' attitudes towards e-learning and their ability to use an e-learning platform. In order to verify this relationship the two variables we first cross-tabulated then the chi-square test of association was used.

Table 58. *Correlation between Are you for or against the Use of Technology and Can You Use an E-learning Platform Easily*

. .

Can you use an e-learning platform easily * Are you for or against the use of technology in class Cross-tabulation

		Are you for or against the use of technology in class			
		For	Against	Neutral	Total
Can you use an e-learning platform easily	Yes	155	4	9	168
	No	21	4	24	49
Total		176	8	33	217

From the table 58, we notice that 155 out of the 176 participants who are for the use of technology in class consider themselves able to use e-learning platforms, while only 21 claim the opposite. On the other hand, 4 out the 8 participants who are against the use of technology for education purposes believe they can use the online platform comfortably, while those who are neutral about technology use in education, 9 of them confirm their ability to use such platforms and 24 claim the opposite. The following bar (figure 26) chart provides a better understanding of the results:

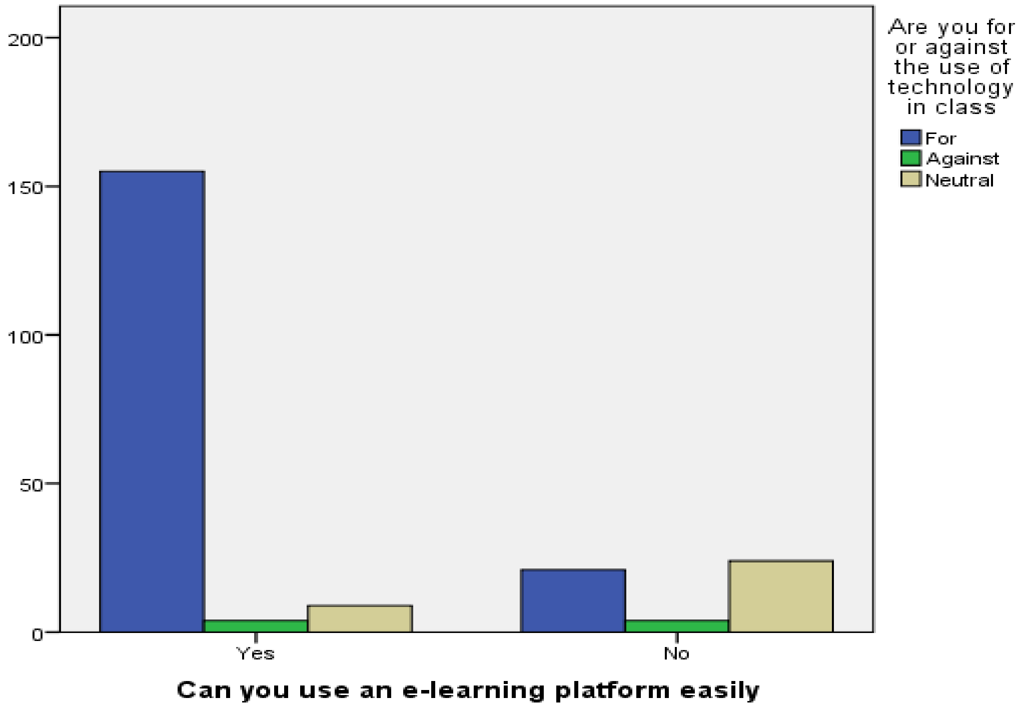


Figure 26. *Bar Graph Showing Correlation between Attitudes towards Technology Use in Class and the Ability to Use an E-Learning Platform*

Table 59. *Results of Chi-square Test of Association-For or Against Technology use /Ability to Use an E-learning Platform*

Chi-square Test

	Value	Df	Assymp. Sig. (2-sided)
Pearson Chi-square	62,326[a]	2	,000
Likelihood Ratio	53,383	2	,000
Linear-by-linear Association	61,789	1	,000
N of Valid Cases	217		

a. 1 cells (16,7%) have expected count less than 5. The minimum expected count is less than 1,81.

The results of the chi-square test show that the significance value is equal to 0.000, which is lower than 0.005, confirming the existence of an influential relationship between the two variables. In order to evaluate the strength of this relationship, the Cramer's V method was adopted. The table 60 below indicates that Cramer's *V* coefficient is equal to 0.536 with a *p*-value of .000, which means that there exist a moderate positive association between the attitudes of students towards the use of technology and their ability to use an e-learning teaching program.

Table 60. *Symmetric Measures-Attitudes towards Technology Use*The Ability to Use E-learning Platforms*

Symmetric Measures

		Value	Approx. Significance
Nominal par Nominal	Phi	,536	,000
	Cramer's V	,536	,000
N of Valid Cases		217	

In addition to that, a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) was used to determine the participants' attitudes and perceptions towards the use of ICT and particularly e-learning in education. The participants were asked to rate how strongly they agree with specific statements related to e-learning content and activities expectations. The table 61 below provides an analysis of the relationships between a set of variables and highlights the different existing correlations in order to explain the participants' perceptions and expectations.

Table 61. *Correlation between Various Variables*

Correlations

Dimension : 1

	Are you for or against Technology in class	The e-learning course contains opportunities	E-learning helps me examine issues, evaluate new ideas	The e-learning site will help me communicate & exchange new ideas	I could learn more effectively via e-learning courses	I can perform better in e-learning quizzes and assessment than in the classroom
Are you for/against technology in class[a]	1,000	,034	,128	,053	,094	,204
E-learning contains opportunities for interact learning[a]	,034	1,000	,336	,287	,386	,423
Elearning helps examine & evaluate new ideas [a]	,128	,336	1,000	,595	,598	,576
E-learning helps me exchange new ideas[a]	,053	,287	,595	1,000	,713	,471
I could learn more via e-learning [a]	,094	,386	,598	,713	1,000	,643
I can perform better in e-learning quizzes and assessment	,204	,423	,576	,471	,643	1,000
Dimension	1	2	3	4	5	6
Eigenvalue	3,079	1,002	,790	,469	,424	,236

a. Group

As indicated in table 61, the strongest associations are between "the e-learning site will encourage me to communicate and exchange ideas with other students and teachers within my department" and "I could learn more effectively via some e-learning courses" variables, with a coefficient of 0.713 (close to 1 than 0). Whereas the second relationship is between "I could learn more effectively via some e-learning courses" and "I am able to perform better in e-learning quizzes and assessment than in the class" variables, with a coefficient of 0.643 (close to 1 than 0). Figure 27, below is a map resulting from the Multiple Corespondence Analysis that aims at sheding the light on the general pattern of responses. We notice that almost all of the responses are centralized around the first dimension.

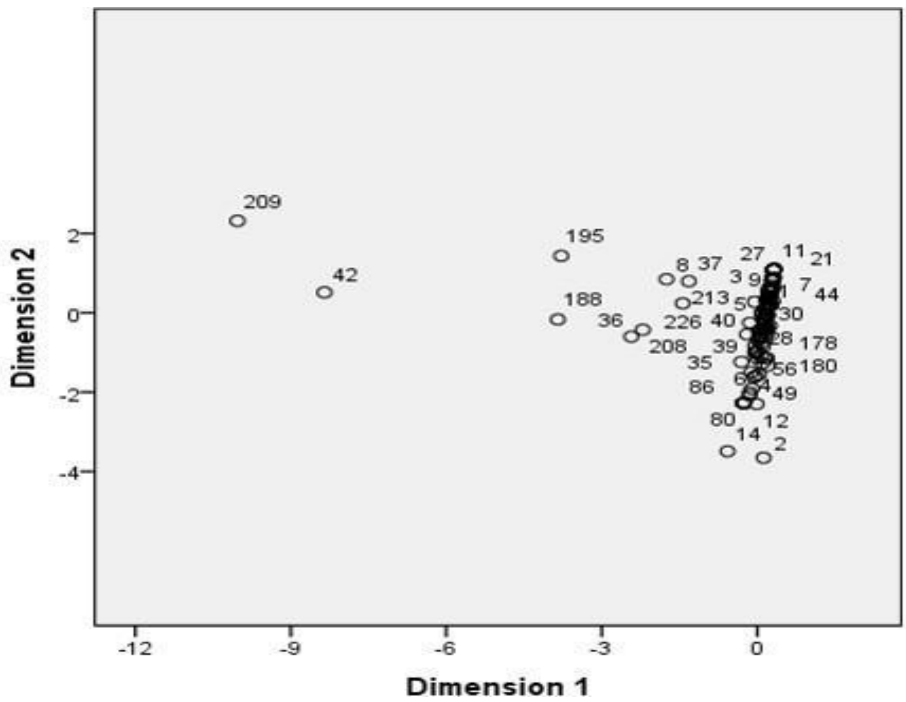


Figure 27. *Perceptual Map through Multiple Correspondence Analysis*

The objective of this research question is to investigate participants' perceptions of the use of e-learning in higher education. Therefore, in order to measure the perceptions and attitudes the researcher opted for a multivariate analysis and more precisely she used Multiple Correspondence Analysis (MCA) as the method of analysis since we deal with multiple qualitative variables. It is also noted that within the framework of this research question, we have a variable to explain "students' attitudes towards e-learning" also called "a research construct" along with explanatory variables (perceived opportunities, specific e-learning activities, usefulness of the institution's e-learning site, students' ability to take courses online, students' ability to use online quizzes, etc.).

Table 62 below, first, helps us to verify whether all the explanatory variables do indeed contribute to the explanation of the research construct. The results show that the six explanatory variables (displayed in the table 61 above) were reduced and classified into two principal groups of variables, called dimensions. According to the same table, we obtained an alpha value equal to 0.812 for the first dimension and an alpha value equal to 0.700 for the second dimension. This means that the first dimension contributes up to 81.2% to the explanation of the research construct, and the second dimension can explain up to 70% of the research construct.

Table 62. *Cronbach's Alpha for the two Dimensions*

Model Summary

Dimension	Cronbach's Alpha	Explained Variance	
		Total (Eigenvalue)	In
1	,812	3,092	,515
2	,700	2,401	,400
Total		5,493	,915
Average	,763[a]	2,746	,458

a. The Average Cronbach's Alpha value is based on the average eigenvalue.

The ultimate goal of the (MCA) is to reduce the number of explanatory variables into two main explanatory dimensions, as shown in the table and the figure below:

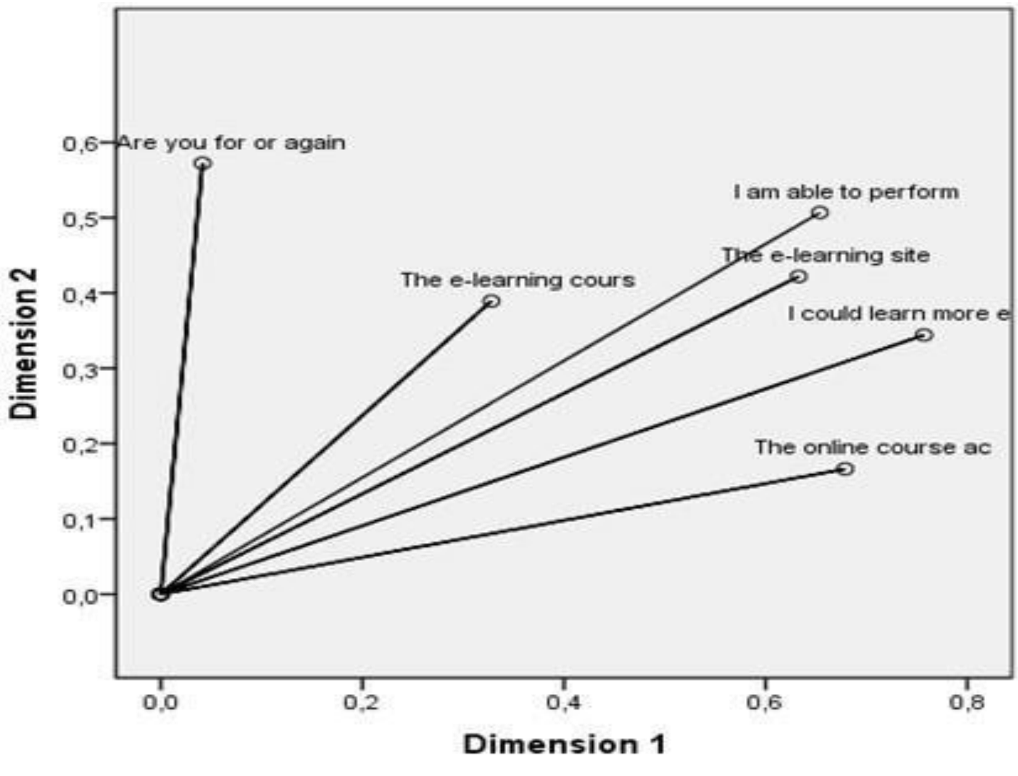
Table 63. *Discrimination Measures of Variables*

Discrimination Measures

	Dimension		Mean
	1	2	
*Are you for or against the use of technology in class	,041	,572	,307
*The e-learning course contained opportunities for interactive learning	,328	,389	,359
*The online course activities will help me to examine issues, to evaluate new ideas, and to apply what II have learned	,679	,166	,423

*The e-learning site will encourage me to communicate and exchange ideas with other students and teachers within my department	,633	,422	,527
*I could learn more effectively via some e-learning courses	,757	,344	,551
*I am able to perform better in e-learning quizzes and assessment better than in the class	,654	,507	,580
Active Total	3,092	2,401	2,746

Discrimination Measures



Variable Principal Normalization

Figure 28. *Joint Plot of Category Points Resulting from (MCA)*

Based on these results, we may name or refer to the first dimension as "features of e-learning" as perceived by the students; it involves the following variables:

- The online course activities will help me examine issues, evaluate new ideas and apply what I have learned
- The e-learning site will encourage me to communicate and exchange ideas with other students and teachers within my department
- I could learn more effectively via some e-learning courses, and
- I am able to perform better in e-learning quizzes and assessment than in the classroom".

While the second dimension refers to "students' attitudes" and it mainly contains: "Are you for or against the use of technology in class".

To summarize, students' attitudes towards the use of e-learning is explained by two main dimensions, namely the characteristics of e-learning as perceived by the learners in terms of effective and interactive learning, creativity, and effective communication, in addition to a second dimension which is reflected in the students' attitudes towards e-learning. This implies that a student builds his/her perception of using e-learning through his/her attitude and perception of the characteristics of e-learning.

3.1.8. Students' Perceived Benefits of E-learning

After examining the students' attitudes and perceptions towards the use of e-learning in learning engineering, this section deals with the benefits of electronic learning as perceived by students. Actually, the integration of e-learning in education, especially for higher educational institutions has many advantages. Several studies in the field of e-learning advocated its effectiveness in teaching and learning and its ability to enhance the efficiency of engineering education. Thus, the sixth research question in the current study examines the perceived advantages of integrating e-learning in tertiary engineering institutions.

- RQ6: What are the perceived educational benefits and opportunities of implementing e-learning technology in teaching and learning higher engineering education?

To answer this question, the researcher first, went through an exploratory phase through open-ended questions that asked participants about the advantages of integrating e-learning in higher education and more specifically in engineering departments. This investigation allowed her to determine the most frequent items, which according to the students, constitute the benefits of e-learning. In a second step, she opted for a quantitative analysis of these variables in order to generate more preciseness. The items that she was able to extract thanks to the exploration step are as follows: ease of use, accessibility, expression of thoughts, autonomy, discussion among learners, and challenging assignments. As for the confirmation stage, it showed that the main benefit perceived by students is the one associated with the ease of use followed by an appreciation of the ease of accessibility as indicated in the figure29 below:

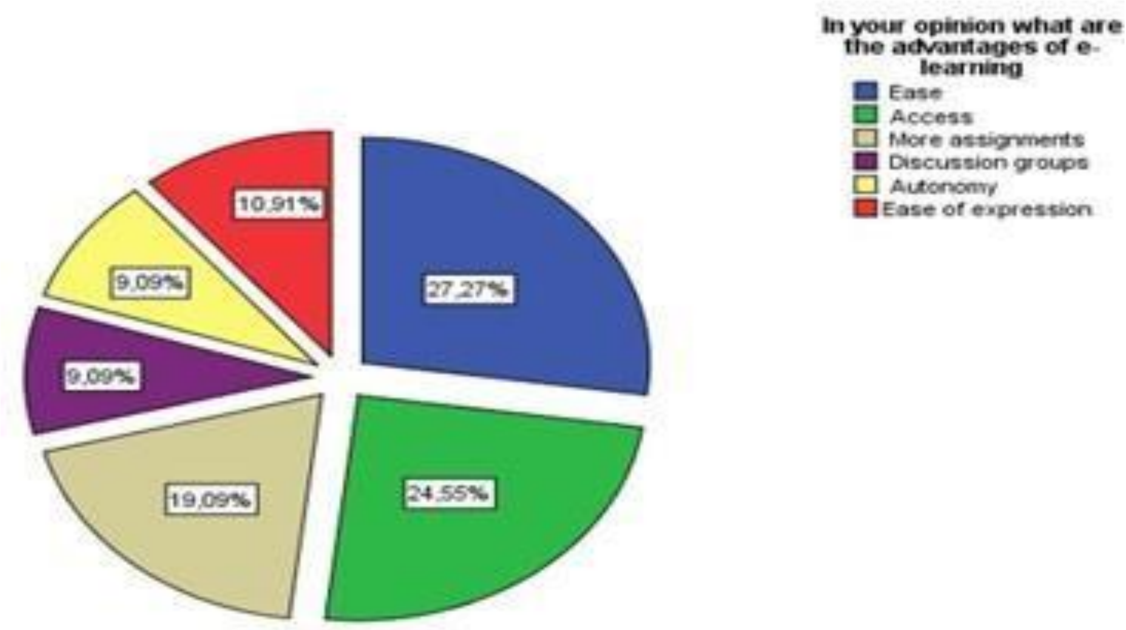


Figure 29. *Frequency Percentage in Relation to the Benefits of E-learning*

Table 64. *Correlation between Students' Attitudes towards the Use of Technology in Class and their Perceived Benefits of E-learning*

Are you for or against the use of technology in class * in your opinion what are the benefits of e-learning cross-tabulation

		Are you for or against the use of technology in class?			Total
		For	Against	Neutral	
In your opinion what are the	Ease of use	22	2	6	30
	Easy access	19	1	5	25

benefits of e-learning?	More challenging assignments	18	2	1	21
	Promote discussion groups	7	0	3	10
	Autonomy	7	1	2	10
	Encourage expression of thoughts	8	1	3	12
Total		81	7	20	108

Table 64 aims to detect a possible relationship between the students' attitudes towards e-learning and the perceived benefits. Based on the results, we first remark that the majority of the students who named an advantage of e-learning, are "for" the integration of e-learning in education with a total number of 81 participants against only 7 and 20 respondents who are "against" or "neutral" respectively. The number of those who are "for" and actually mentioned a benefit related to the “ease of use” is 22 participants, which constitutes 27, 16% of the sample (see figure 30).

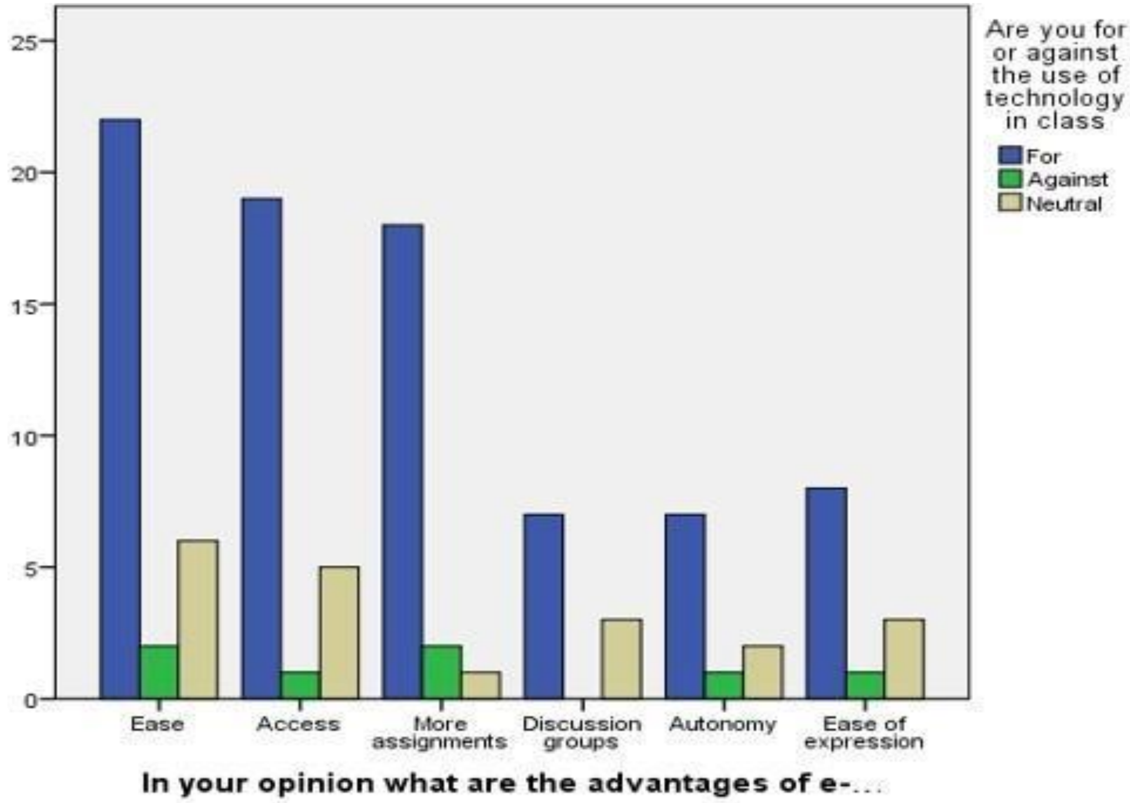


Figure 30. *Perceived Advantages of E-learning*

The table 65 below corresponds to the chi-square test, which allows us to verify whether there is a real interdependence between the two qualitative variables examined or not. In our case, we find that the majority of people who mentioned the benefits of e-learning are those who answered "for" for its integration. In other words, the people who actually named the advantages of e-learning are the ones who have a positive attitude towards e-learning integration. This is explained by the significance of the chi-square test which is equal to 0.000 (much lower than 0.005), confirming the existence of a mutual influence between the two variables.

Table 65. *Results of the Chi-square Test of Association- Students' Attitudes towards the Use of Technology and Benefits of E-learning*

Chi-square Tests

	Value	Df	Approx. Sig. (2-sided)
Pearson Chi-square	5,162[a]	10	,000
Likelihood Ratio	6,542	10	,000
Linear-by-linear Association	,211	1	,000
N of Valid Cases	108		

a. 11 cells (61, 1%) have an expected count less than 5. The minimum expected count is less than 0, 65.

The Cramer's V test (see table 66) is of paramount importance for this type of association, as it informs us about the strength of the existing relationship. In the context of this research question, though there exists an interdependent relationship between the two variables, the results of the Cramer' V test indicate a very weak association between students' attitudes and the perceived benefits of e-learning (with a coefficient value of only 0,219 (21.9%)). In other words, a negative attitude of the student does not necessarily mean that he/she does not perceive any advantage of e-learning. To demonstrate this result, if we go back to the correlation table above (table 64) we find that 7 out of the 108 respondents who provided an advantage of e-learning are "against" its use in learning engineering.

Table 66. *Measures of Association- Students' Attitudes towards the Use of Technology and Benefits of E-learning*

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,219	,000
	Cramer's V	,155	,000
N of Valid Cases		108	

3.1.9. Students' Perceived Disadvantages of E-learning

As discussed in the literature review, although e-learning can improve the speed of learning and simplify its process, some researchers believe that its inappropriate use disrupts the teaching and assessment process. Therefore, the seventh research question investigates the disadvantages of adopting e-learning in higher education as perceived by students.

- RQ7: What are the perceived disadvantages of integrating e-learning in higher engineering education?

Following the same steps of the previous RQ, the researcher was able to extract the main disadvantages perceived by students thanks to the exploration phase, considering that the number of people who provided an answer to this question does not exceed 39 participants; they constitute 17.1% of the sample. The main perceived disadvantages are lack of technical training, students being passive, health damage, lack of assignments, waste of time, lack of network access, and lack of control. According to the findings, the main disadvantage of e- learning perceived by students is related to the professors' lack of control over their students, as shown in table 67 and bar chart 31 below:

Table 67. *Correlation between Students' Attitudes towards the Use of Technology in Class and Disadvantages of E-learning?*

Are you for or against the Use of Technology in Class * in your Opinion what are the Disadvantages of E-learning Cross-tabulation

		Are you for or against the use of technology in class?			Total
		For	Against	Neutral	
In your opinion what are the disadvantages of e-learning?	Don't know	1	0	0	1
	Lack of technical training	1	0	0	1
	Students being passive	7	0	1	8
	Health damage	4	1	1	6
	Lack of assignments	2	0	0	2
	Waste of time	3	0	1	4
	Lack of network access	3	0	0	3
	Lack of control	11	0	3	14
Total		32	1	6	39

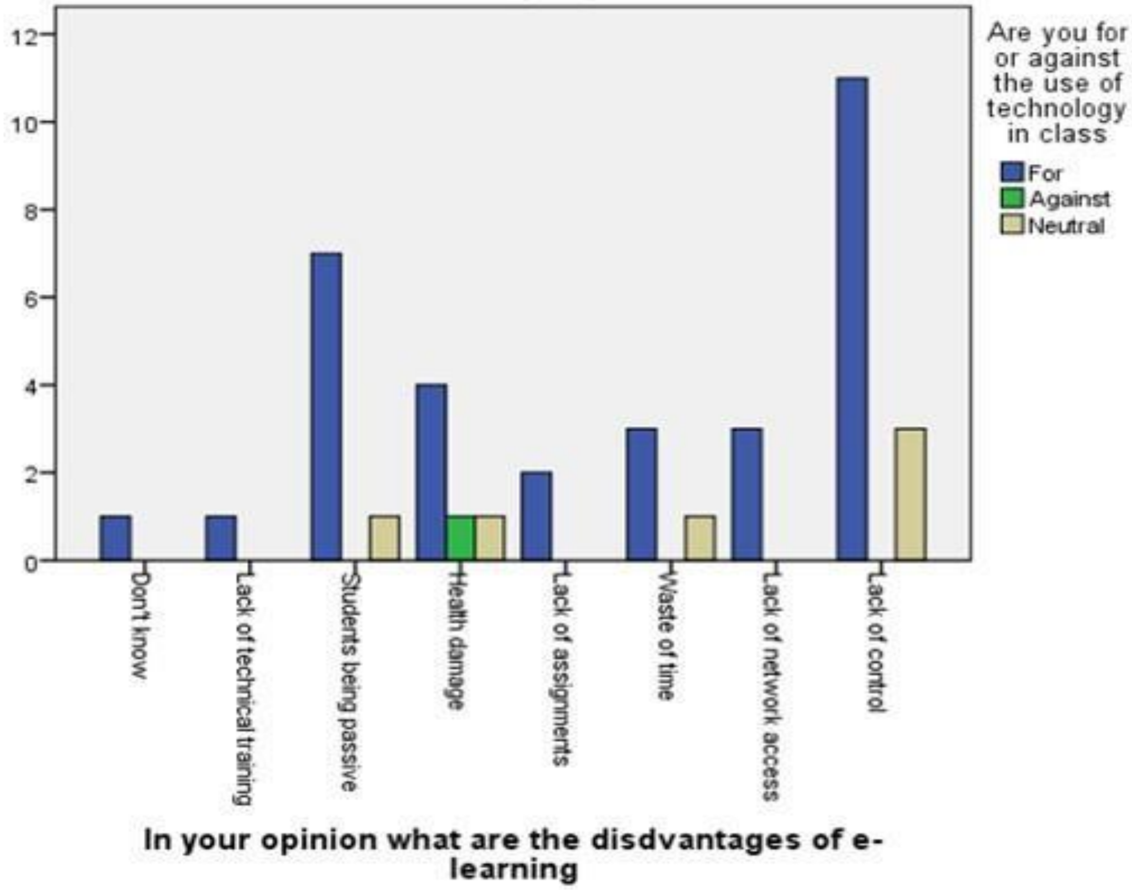


Figure 31. *Students' Perceived Disadvantages of E-learning*

This research question also examines whether there is an association between the positive or negative attitudes of students towards the integration of e-learning and the disadvantages associated with it. To confirm or deny this hypothesis of interdependence between these two qualitative variables, the researcher opted for the chi-square test and the Cramer's V coefficient.

Table 68. *Results of Chi-square Test of Association-Students' Attitudes and Disadvantages of E-learning*

Chi-square Tests

	Value	Df	Approx. Sig. (2-sided)
Pearson Chi-square	7,721[a]	14	,903
Likelihood Ratio	6,964	14	,936

Linear-by-linear Association	,213	1	,645
N of Valid Cases	39		

a. 22 cells (91, 7%) have an expected count less than 5. The minimum expected count is less than 0, 3.

The Chi-square test shows a margin of error of 90, 3% (0,903), which is higher than the expected margin of error of only 5%. In this case, we can disprove the relationship between the two variables. Therefore, the disadvantage perceived by the students regarding the integration of e-learning in the engineering department does not depend on their positive or negative attitude and vice versa. In other words, a positive attitude of the student does not necessarily mean that he/she does not perceive any disadvantage of e-learning. To demonstrate this result, if we go back to the correlation table above (table 67), among the 14 participants who think that faculty control over their students in e-learning is problematic, 11 are basically for the integration of e-learning in their departments.

3.1.10. The Integration of E-learning in Moroccan Higher Education

3.1.10.1. The Current Practice of E-learning in Higher Engineering Institutions

The Integration of e-learning in Higher Education (HE) is becoming a very common trend in the world's largest universities. However, since engineering education is based on science and mathematics, makes it considerably different from other disciplines. In fact, although the adoption of e-learning has reached advanced stages in many countries all over the world, it is still in its infancy in Morocco (Ajhoun & Daoudi, 2018). In this regard, the eighth research question attempts to identify the extent to which e-learning is manifested in higher engineering institutions in order to support students' learning.

- RQ 8: To what extent e-learning is manifested in Moroccan higher engineering education?

In order to answer this question, the respondents were first asked whether the institution to which they belong offers online courses or not.

Table 68. *Frequency and Percentage for the Institution Inclusion of Online Courses*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	20	8,8	8,8	8,8
	No	208	91,2	91,2	100
Total		228	100	100	

Based on table 68, 20 out of the 228 respondents confirmed that the academic program includes online courses; they represent 8.8% of the sample. On the other hand, the vast majority of the surveyed respondents (91.2%, N=208) claimed the opposite.

Moreover, the respondents were required to evaluate different elements in their institutions, including the university infrastructure and e-resources and the teaching methods. In this sense, a five-point Likert scale ranging from very dissatisfied (1) to very satisfied (5) was used to determine the participants' evaluation of various components in their departments. The evaluation is made at the level of the degree of students' involvement in classrom discussions, the quality of the teaching methods, the content and pedagogical objectives of the courses, the degree of difficulty of the courses, the variety of pedagogical and assessment activities as well as the level of lectures and presentations. The following table 69 represents the answers collected from the students regarding their degree of satisfaction with different items in the engineering departments :

Table 69. *Frequency of Students' Satisfaction with their Departments*

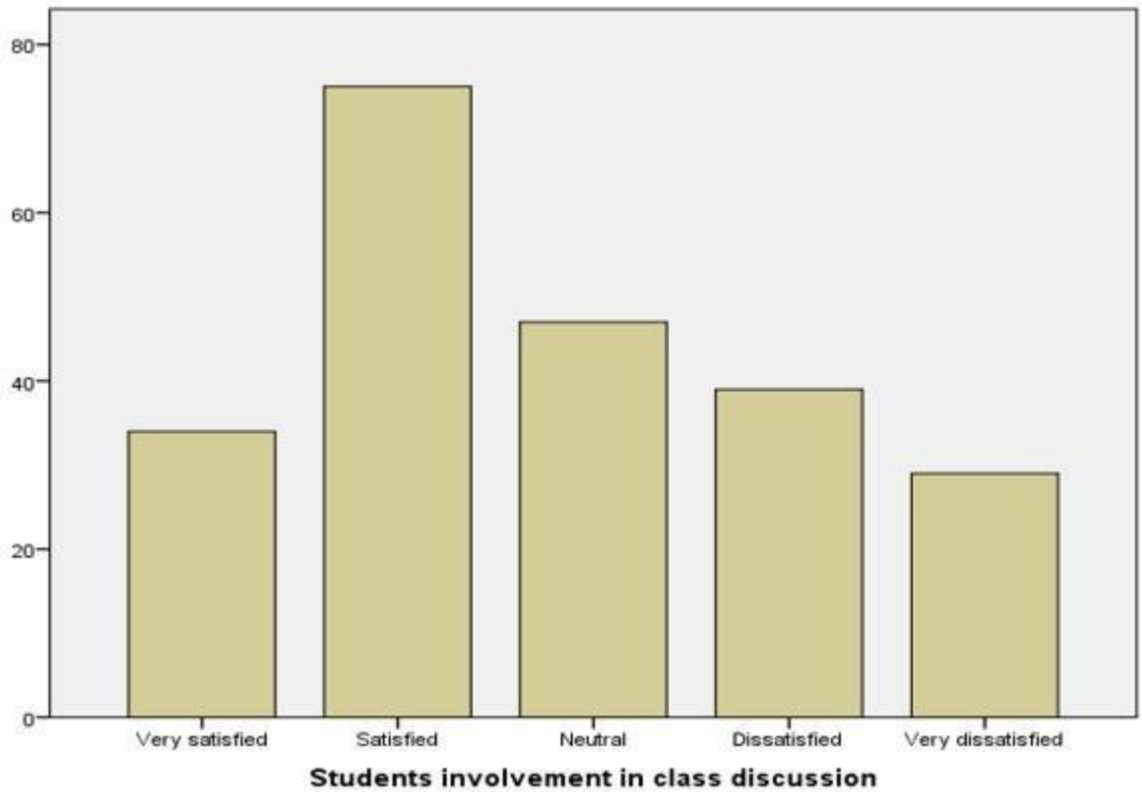
Satisfaction Frequencies

		Reponses		Percentage of observations
		N	Percent	
Satisfaction with the departments[a]	Very satisfied	120	6,0%	52,6%
	Satisfied	491	24,7%	215,4%
	Neutral	725	36,5%	318,0%
	Dissatisfied	432	21,8%	189,5%
	Very dissatisfied	216	10,9%	94,7%
Total		1984	100,0%	870,2%

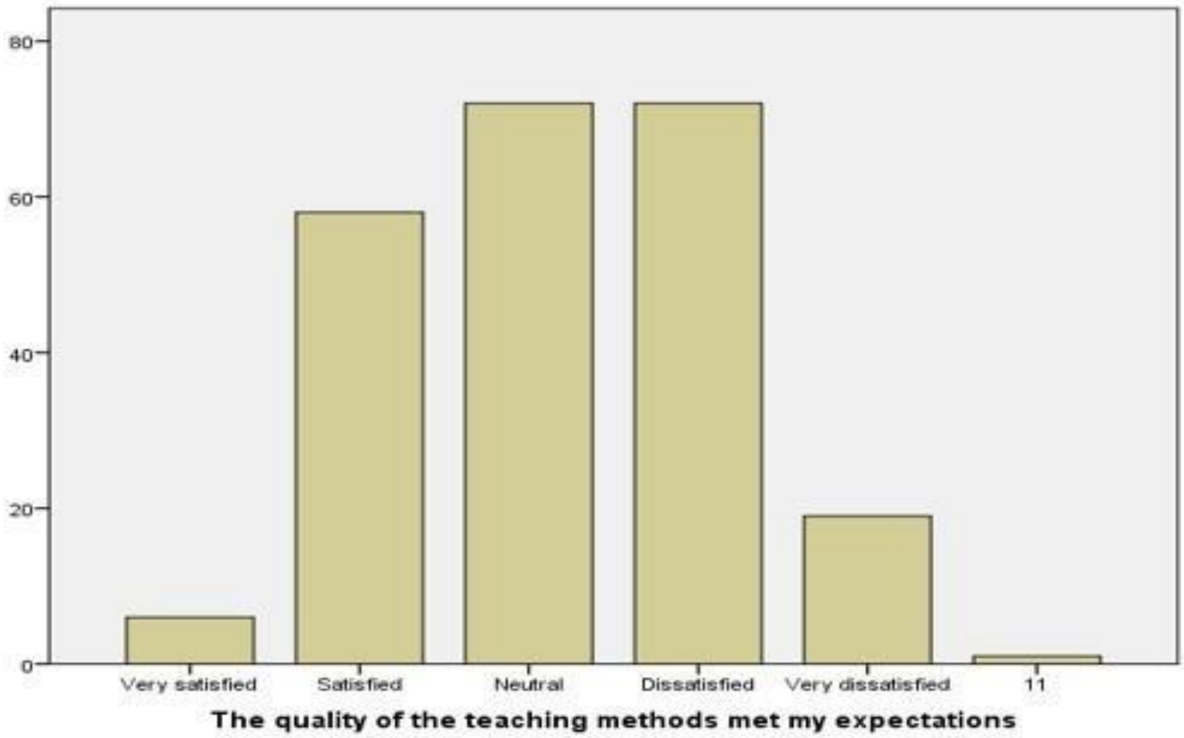
In general, and based on the results in the table 69 above, students can be classified into three large groups, with each group representing one-third of the sample: satisfied (24, 7%) to very satisfied (6, 0%) which constitute 30.7 per cent of the sample, neutral forms (36.5%), and dissatisfied (21, 8%) to very dissatisfied (10, 9%) represent 32.7% of participants.

In order to understand the distribution of these results, we will proceed to a pictorial or graphical representation of each item being evaluated for satisfaction as follows:

- The items that explain students' satisfaction are mainly the involvement of students in class discussions, the quality of the teaching methods in addition to the consistency of course objectives and content.



Figures 32. *Students' Involvement in Class -Degree of Satisfaction-*



Figures 33. *Quality of Teaching Methods-Degree of Satisfaction-*

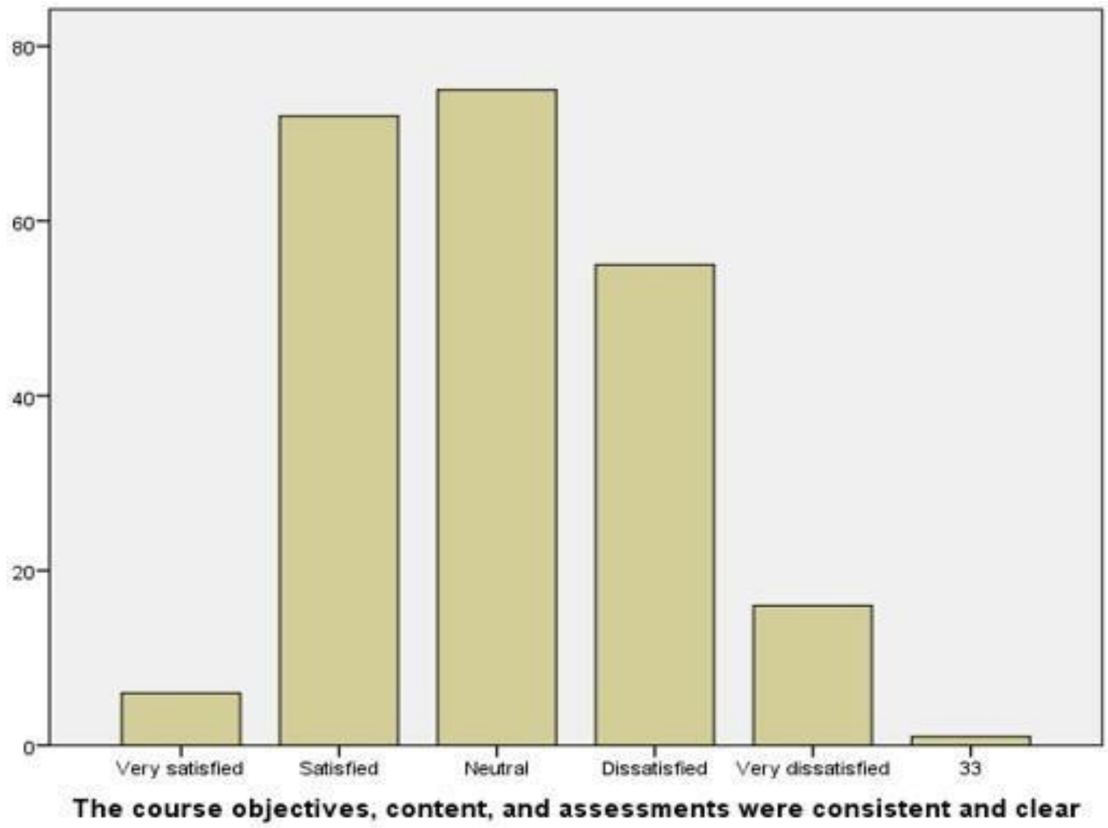
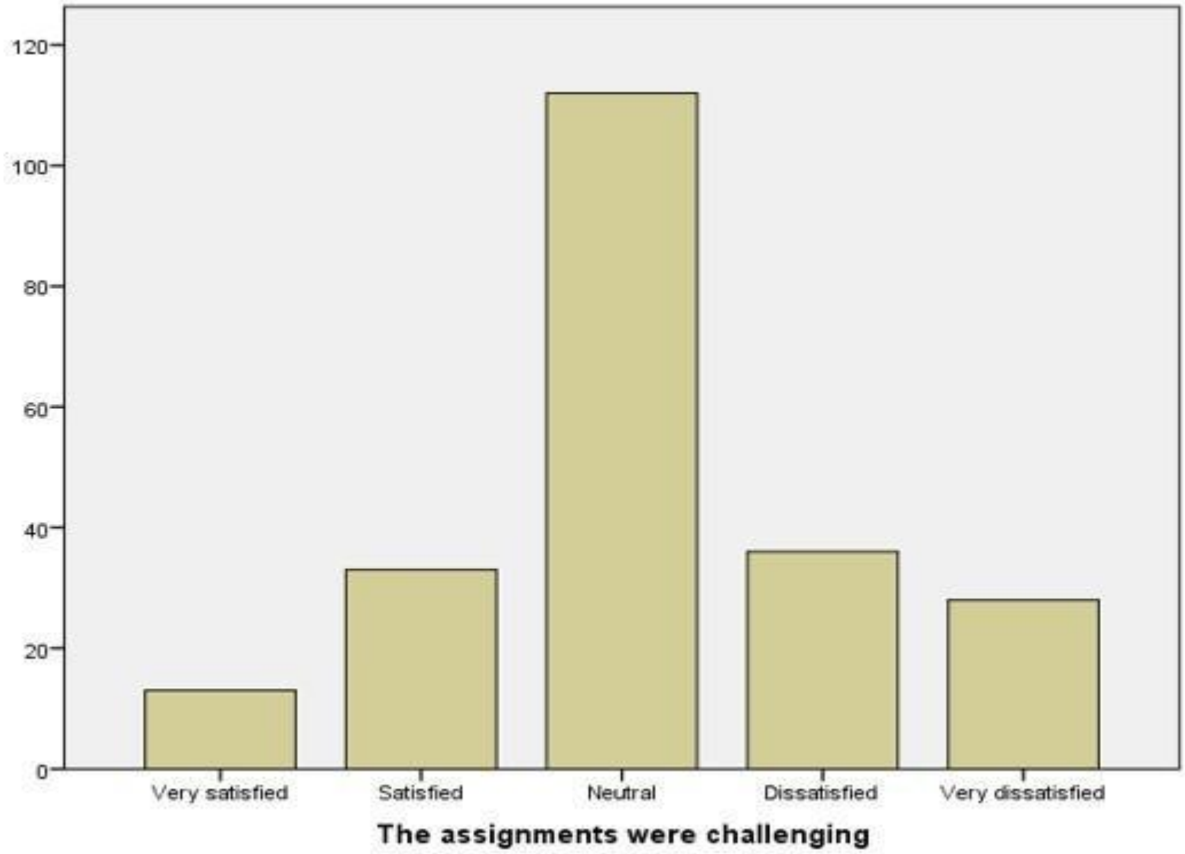
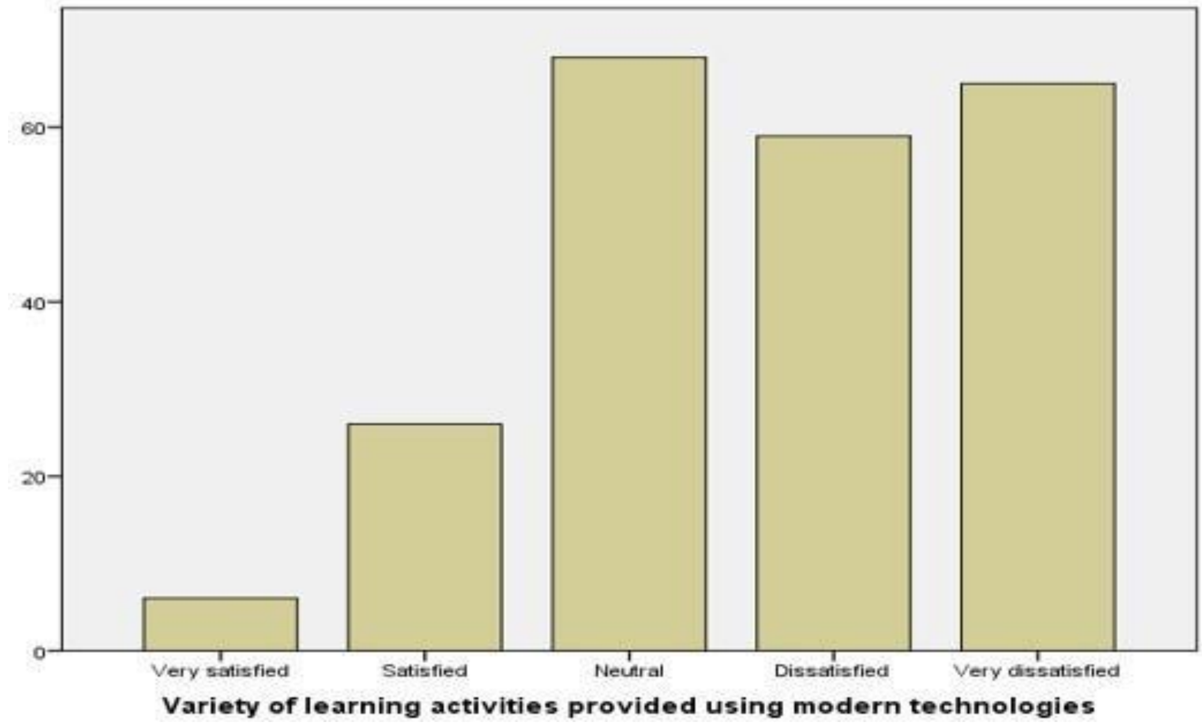


Figure 34. *The Course Objectives and Content-Degree of Satisfaction-*

- Students are fairly neutral with respect to the level of difficulty of the assignments, the level of presentations and lectures, and the variety of assessment tools as seen in the charts below:



Figures 35. *The Assignments -Degree of Satisfaction-*



Figures 36. *Variety of Assessment Methods -Degree of Satisfaction-*

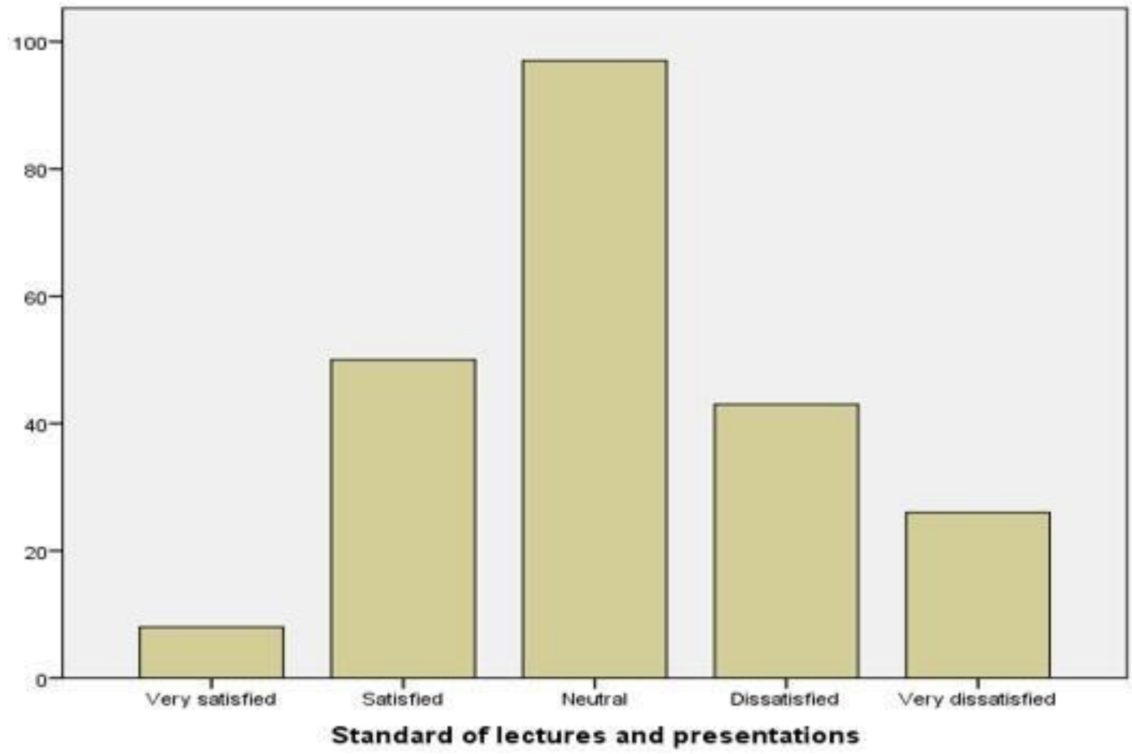


Figure 37. *Standard of Lectures and Pesentations-Degree of Satisfaction-*

- While the source of dissatisfaction is mainly related to the lack of a variety of technology-based learning activities.

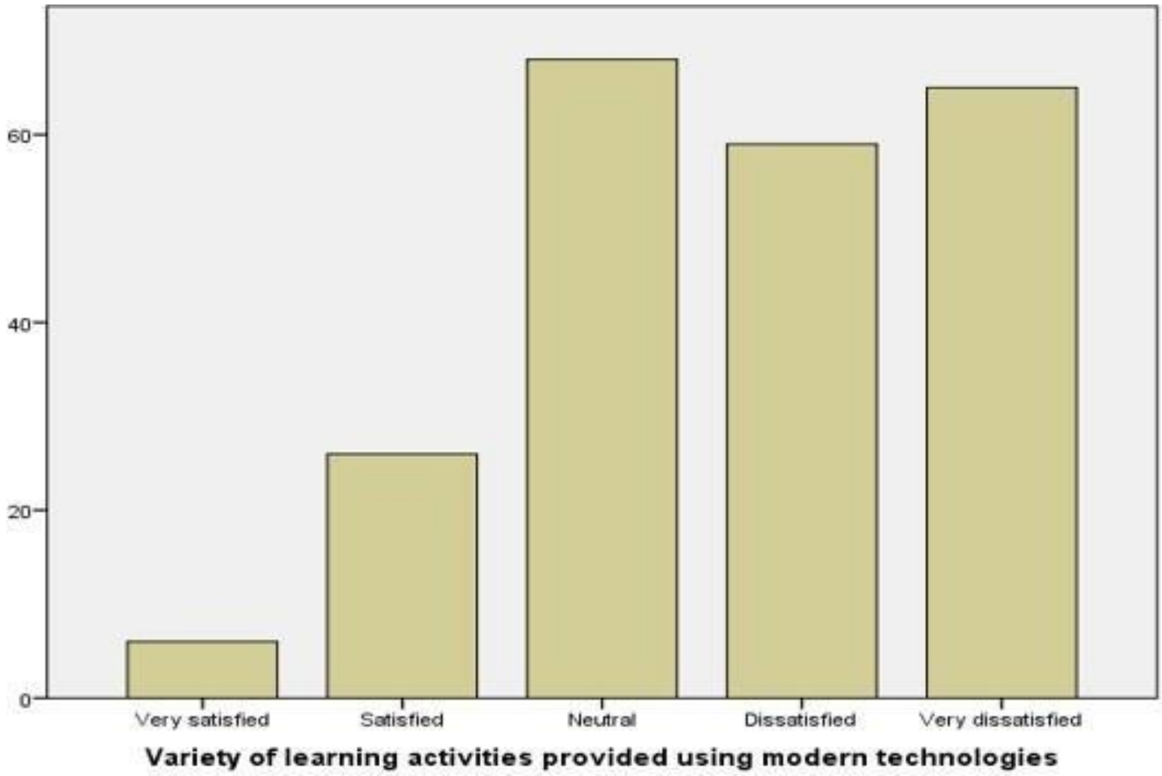


Figure 38. *Technology-Based Activities-Degree of Satisfaction-*

In addition to asking participants to evaluate the different components in their departments, the questionnaire also included a five-point Likert type-rating scale ranging from poor (1) to high (5) on which the respondents were asked to evaluate the university infrastructure conditions and e-resources. The evaluation is made at the level of library resources, laboratories, multimedia room, classroom equipment (computers/data show), website of the university, e-learning platforms, interactive whiteboard, and the Internet connection. The following table represents the answers collected from the students regarding their evaluation of the resources:

Table 70. *Students' Evaluation of the University Resources*

Educational _Resources_and_Facilities _Evaluation Frequencies

		Reponses		Percentage of Observations
		N	Percentage	
Resources & facilities Evaluation[a]	Poor	901	46,6%	419,1%
	Low	390	20,2%	181,4%

	Neutral	345	17,8%	160,5%
	Good	268	13,9%	124,7%
	High	31	1,6%	14,4%
Total		1935	100,0%	900,0%

a. Group

In general, students' evaluation of these items are mainly negative as depicted in table 70. Almost 67% of the students gave a rating of "poor" (46.6%) or "low" (20.2%) to the resources and facilities provided by their institutions, while 17, 8% are neutral, however, only 15.5% consider the efforts made as "good" (13.9%) or "high" (1.6%).

Therefore, to understand the distribution of these findings, we will proceed to agraphical representation of some items evaluated by students starting from “poor” evaluation to “high” evaluation:

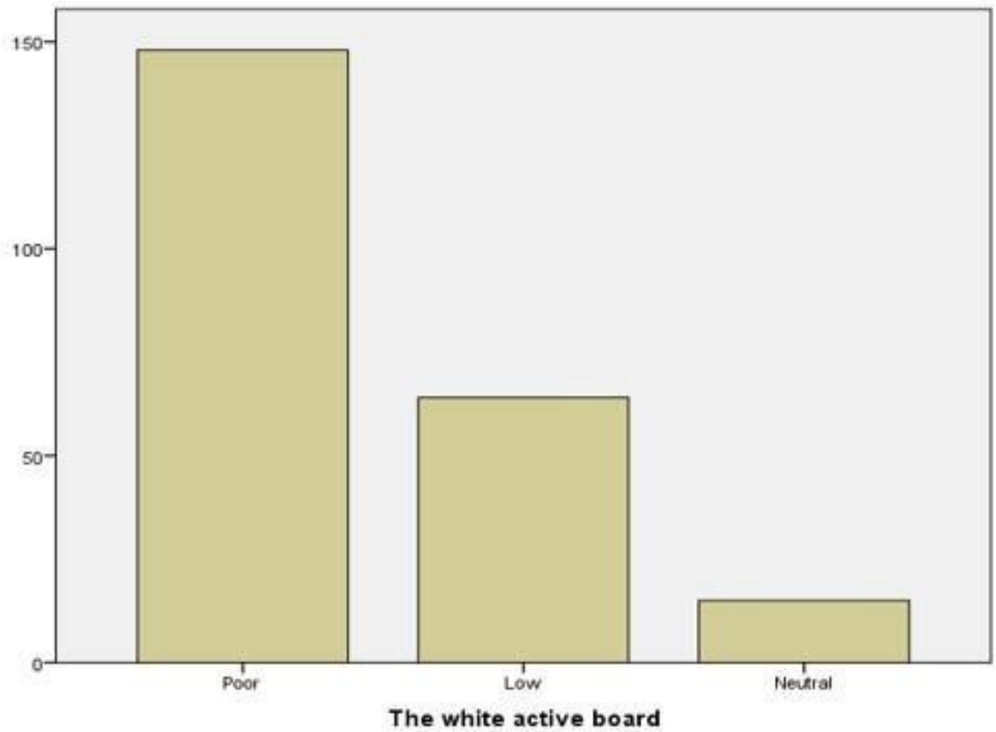


Figure 39. *The Interactive Whiteboard -Evaluation-*

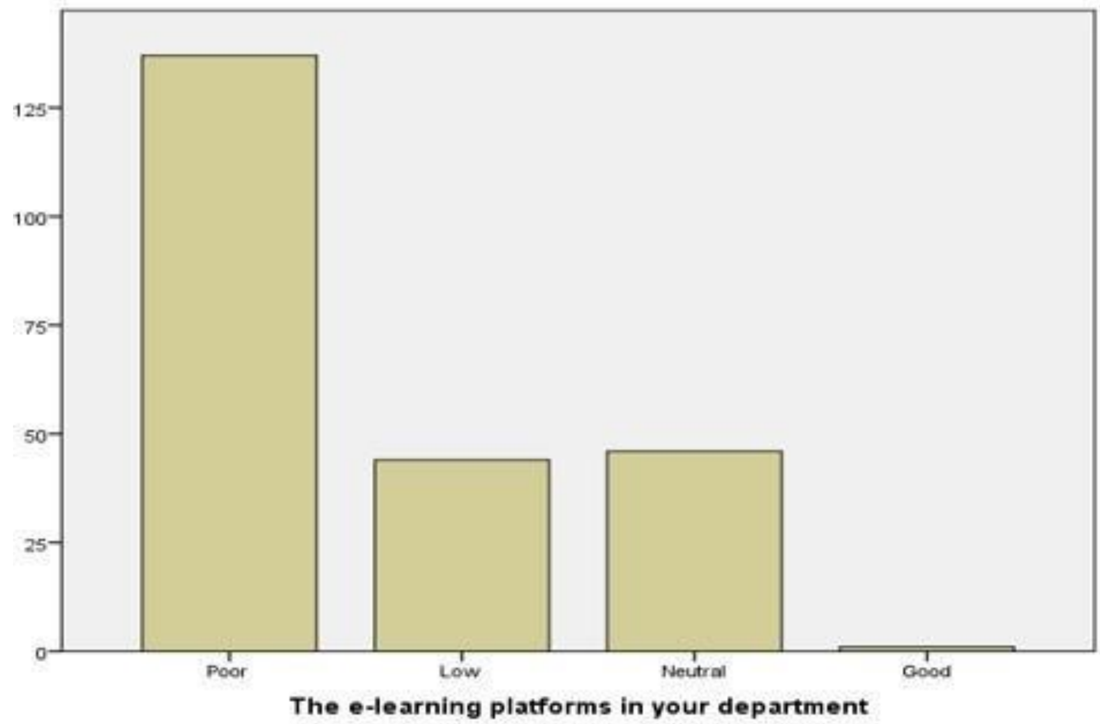
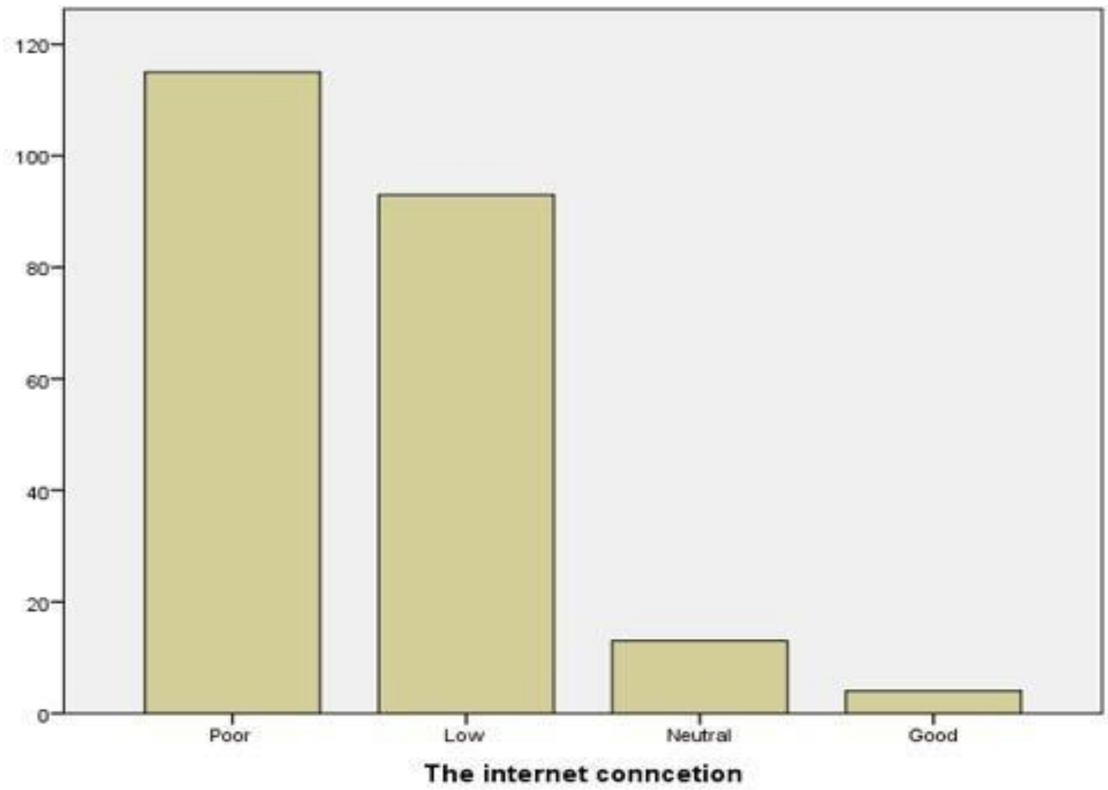
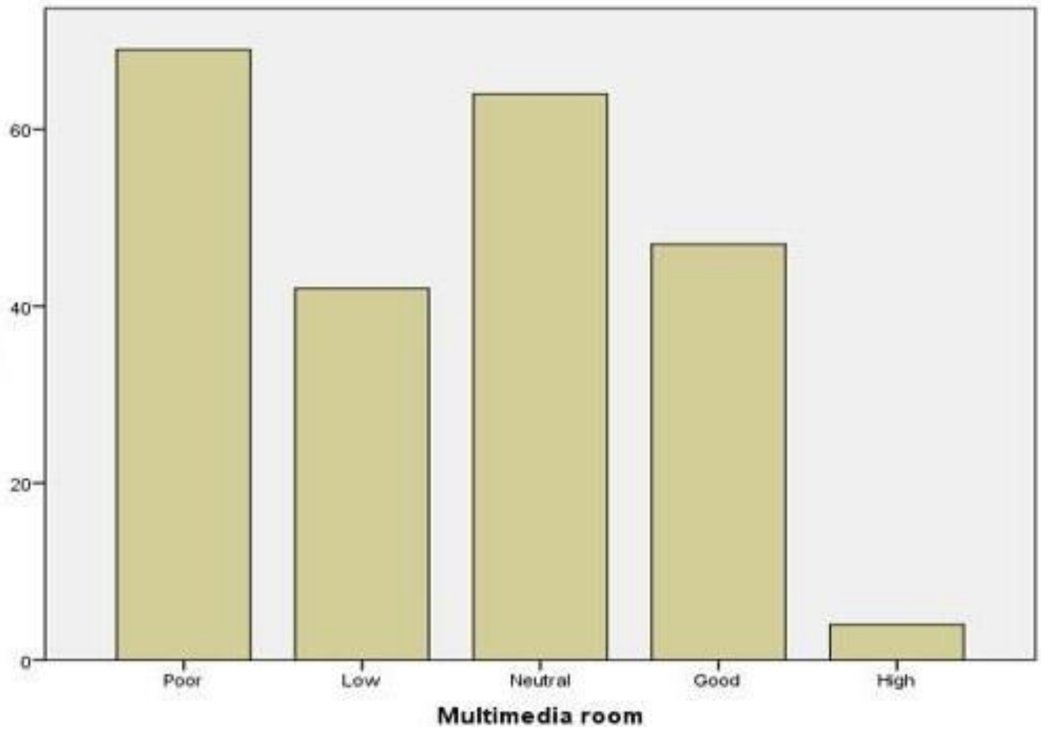


Figure 40. *The E-Learning Platform-Evaluation*



Figures 41. *The Internet Connection-Evaluation-*



Figures 42. *The Multimedia Room-Evaluation-*

As depicted in the figures above, the main resources that were rated as poor according to students from both research sites are the white active board, the multimedia room, the e-learning platforms and the Internet connection, which reflect the lack of adequate digital resources and infrastructure that promote the effective integration and adoption of e-learning in engineering education.

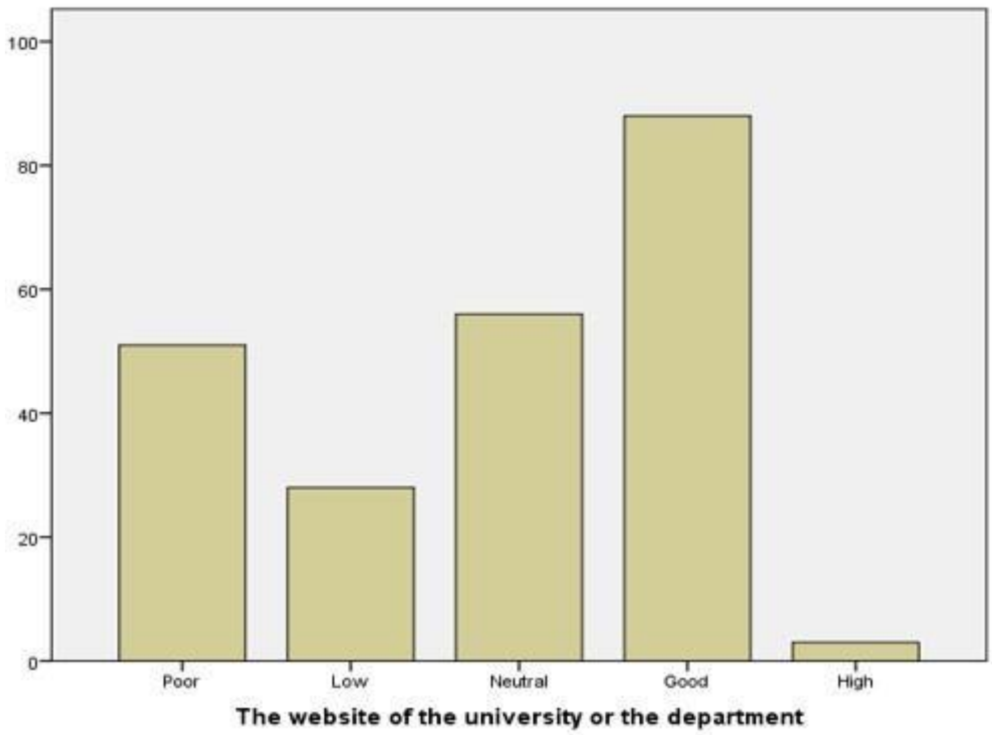


Figure 43. *The Website of the University -Evaluation-*

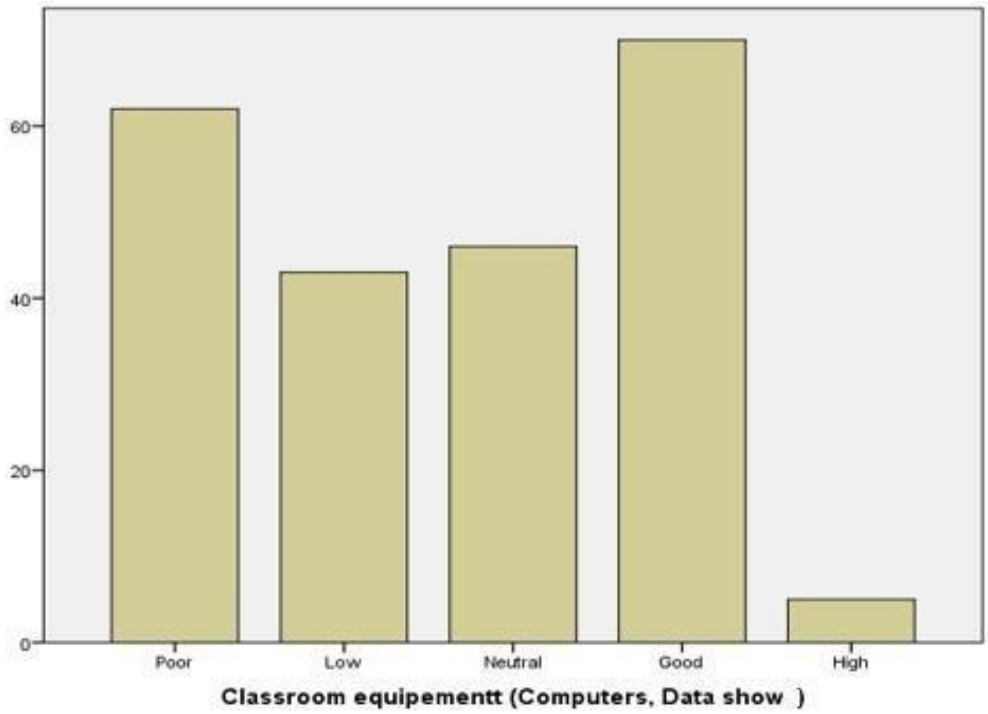


Figure 44. *The Classroom Equipment-Evaluation-*

Moreover, based on the bar graphs above, the only two items that were somewhat rated as good by students are the classroom equipment and the website of the university; however, we still notice the presence of the evaluation "poor" and "low" for both items.

In short, from the obtained results we can say that students' attitudes towards the current facilities and institutional infrastructure are negative, especially their evaluation of the current digital educational resources that play a significant role in promoting and supporting the implementation of e-learning in higher education.

3.1.11. Technological Aspect Factors of E-learning Readiness in Public and Private Higher Engineering Institutions

Among the critical factors that contribute to the effective and efficient adoption of e-learning in education is the technological aspect. Fisser (2001) argues that "for successful e-learning implementation in institutions of higher education, institutions must ensure that appropriate technologies are available for all instructors and students and that there should be enough facilities and sufficient access to these facilities" (as cited in Baporikar 2013, p.131). Therefore, this section attempts to explore the extent to which Moroccan public and private higher engineering institutions provide technology-based resources that promote the use of e-learning in teaching and learning. In this sense, the ninth research question examines whether there is a difference among public and private engineering institutions readiness in terms of technology-based factors influencing the integration of e-learning.

- RQ 9: Is there any difference regarding e-learning readiness between public and private Moroccan HEIs?

To answer this question, respondents were required to evaluate the quality of the following e-resources in their departments, namely (the website of the university, the e-learning platform, the e-learning center, the Internet connection and the interactive whiteboard).

3.1.11.1. Evaluation of the Internet Connection

Accessing the Internet and the Internet speed are one of the critical factors that determine the success or failure of an e-learning system. To identify students evaluation of the Internet connection in their institutions, the researcher first cross-tabulated the two variables "the Internet connection" and "the public/private institution".

Table 71. *Correlation between the Internet Connection and the Private/Public Sector*

The Internet Connection * University/School Cross-tabulation

		University/School		Total
		ENSA	EMSI	
The-Internet Connection	Poor	85	30	115
	Low	20	75	95
	Neutral	12	2	14
	Good	1	3	4
Total		118	110	228

In general, we notice that the evaluation attributed by respondents from both sectors to the Internet connection is very negative. However, public school students (ENSA) are the ones who most qualify the Internet connection as poor, they constitute 73.91% (N=85) of the 115 respondents who answered "Poor" against only 26.02% of the students who belong to the private school (EMSI) with a total number of 30 participants. On the other hand, private school students (78.9%, N=75) are the ones who rated Internet connection as low compared to those belonging to the public sector.

Second, since we deal with qualitative variables, it is necessary to use the Chi-square test in order to determine the degree to which both variables associate or covary with each other.

Table 72. *Results of the Chi-square Test of Association-Internet Access and Public/Private Sector*

Chi-square Test

	Value	Df	Approx. Sig. (2-sided)
Pearson Chi-square	68,393[a]	3	,000
Likelihood Ratio	72,745	3	,000
Linear-by-linear Association	21,832	1	,000
N of Valid Cases	228		

a. 2 cells (25, 0%) have an expected count less than 5. The minimum expected count is less than 1, 96.

Based on the results of the chi-square test (Sig=0,000 < 0,005) calculated on the basis of the correlation between the two variables, we see that there is indeed an influentialassociation between the institution to which the students belong and their evaluation of the Internet connection

Table 73. *Measures of Association-the Internet Access and Public/Private Sector*

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,551	,000
	Cramer's V	,551	,000
N of Valid Cases		228	

To obtain accurate measurements and to identify the strength of this relationship we used Cramer's V coefficient of association. As indicated in the above table, the result of the test equals 0.551 with a *p*-value of .000, which means that there exist a moderate or medium association between the private/public sector and students' evaluation of the Internet connection. Figure bellow is a bar chart that concludes the evaluation of the Internet connection according to the public and private institutions.

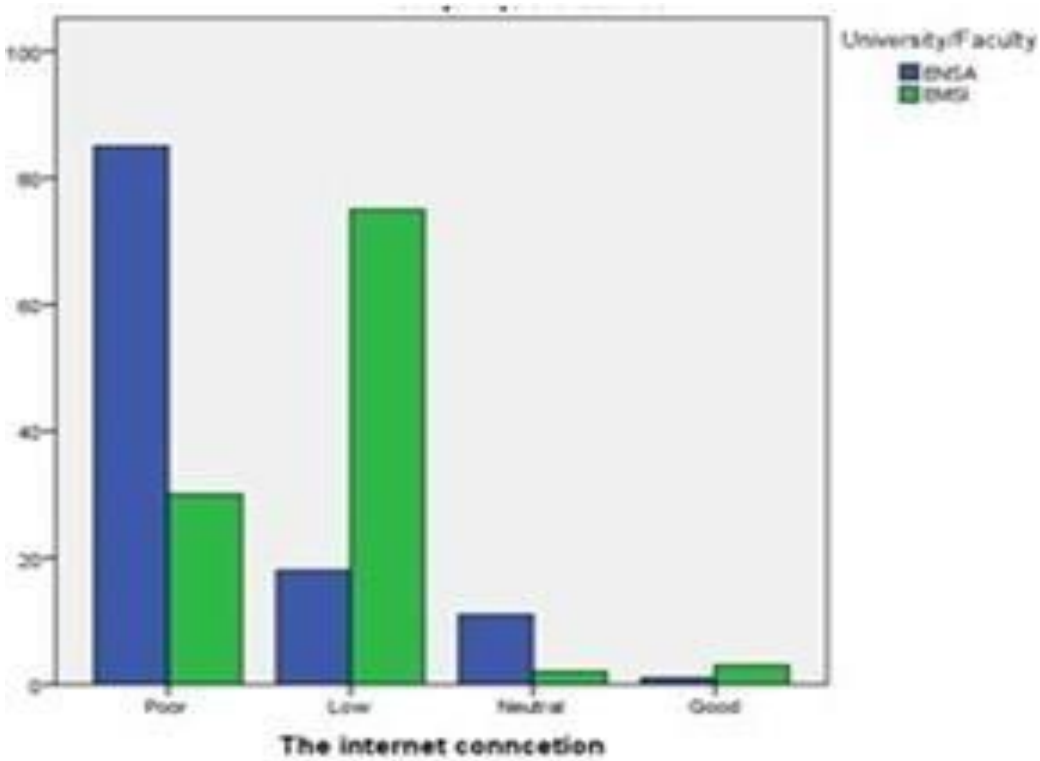


Figure 45. *Evaluation of the Internet Connection in Relation to the Public/Private Sector*

3.1.11.2. Evaluation of the Website of the Institution

In order to answer this question, the researcher first cross-tabulated the two variables (the website of the institution and the public/private sector). Moreover, since we deal with qualitative variables, it is necessary to use the Chi-square test in order to determine the degree to which both variables associate or covary with each other.

Table 74. *Correlation between the Website of the Institution and the Private/Public Sector*

University/School * the Website of the University Cross-tabulation

		University/School		Total
		ENSA	EMSI	
The website of the university or the department	Poor	31	21	52
	Low	26	3	29
	Neutral	36	20	56
	Good	22	66	88
	High	3	0	3
Total		118	110	228

From the table 74 we notice that 66 out of the 110 respondents belonging to the private school (60% of the sample) rate their institution's website as "good" while only 18.64% (N=22) of respondents belonging to the public sector rate their school's website as "good". We can also notice that the majority of respondents who give poor and low ratings to their institution’s website are from the public sector.

Table 75. *Results of Chi-square Test* of Association-*the Website of the Institution and Public/Private Sector*

Chi Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-square	48,320[a]	4	,000
Likelihood Ratio	53,003	4	,000

Linear-by-linear Association	18,125	1	,000
N of Valid Cases	228		

a. 2 cells (20, 0%) have expected count less than 5. The minimum expected count is less than 1, 46.

As indicated in table 75 above, the significance of the test is equal to 0.000 which is lower than 0.005, confirming the existence of a mutual influence between the two variables. Moreover, in order to complete our answer, we also wanted to verify the degree of importance of this influence. We therefore used Cramer's *V* coefficient, which allows us to evaluate the relationship between the two variables in which the relationship is said to be strong when the coefficient is equal or superior to 0.70. In our case, the table 76 below indicates that Cramer's *V* coefficient is equal to 0.462 with a *p*-value of .000, which means that there exist a moderate association between the private/public sector and students' evaluation of the website. In other words, the evaluation given by the student to the website depends on the institution to which he or she belongs. The bar graph 46 below represents the evaluation of the website according to both public and private sectors.

Table 76. *Measures of Association-the Website of the Institution and Public/Private Sector*

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,462	,000
	Cramer's V	,462	,000
N of Valid Cases		228	

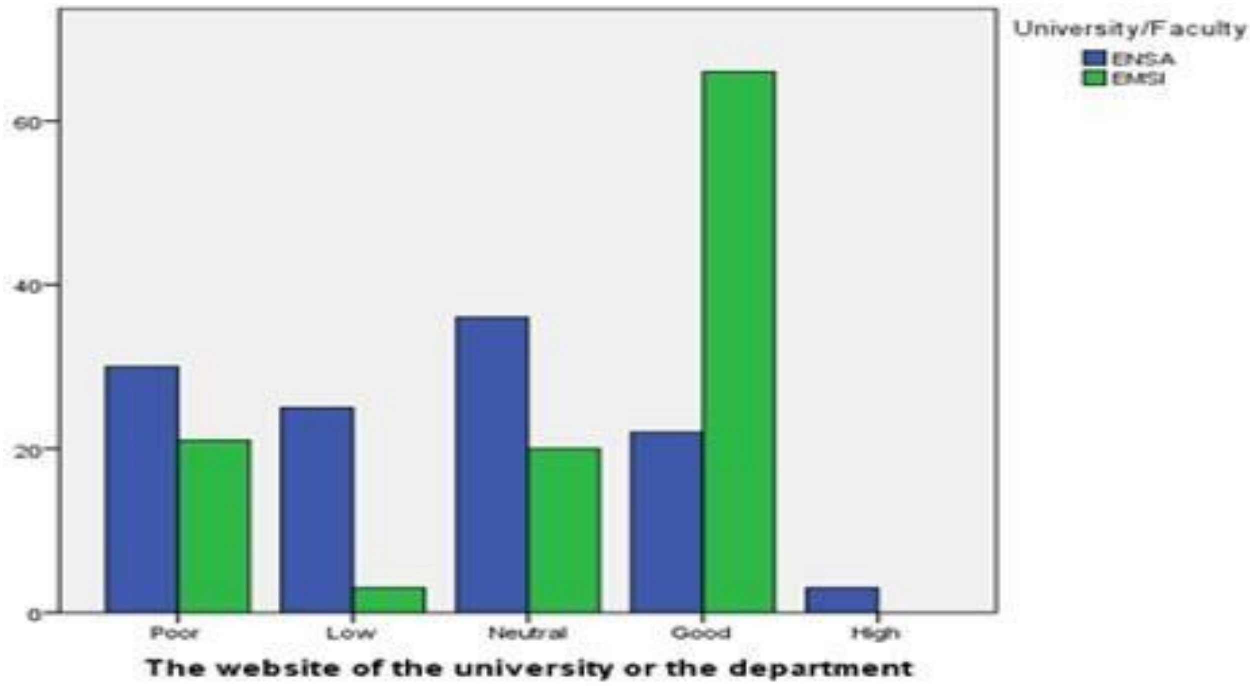


Figure 46. *Evaluation of the Website of the Institution in Relation to Public/Private Sector*

3.1.11.3. Evaluation of the E-learning Platform

Table 77. *Correlation between an E-learning Platform and the Private/Public Sector*

The e-learning platform * the Institution/School Cross-tabulation

		Institution/School		
		ENSA	EMSI	Total
The e-learning platform in your department	Poor	65	74	139
	Low	36	9	45
	Neutral	16	26	45
	Good	1	0	1
Total		118	110	228

Regarding the evaluation of the e-learning platform, we notice that there is no big difference between the answers provided by public and private students. The majority of respondents (80%) attributed a negative evaluation (poor/N=139) (low/N=45) to the efforts made by their institutions concerning the e-learning platform.

Table 78. *Results of the Chi-square Test of Association-E-learning Platform and Public/Private Sector*

Chi-square Test

	Value	Df	Approx. Sig. (2-sided)
Pearson Chi-square	23,185a	3	,000
Likelihood Ratio	25,065	3	,000
Linear-by-linear Association	,023	1	,000
N of Valid Cases	228		

According to the results of the chi-square test (Sig=0,000 < 0,005) calculated based on the correlation between the two variables, we see that there is indeed an influential association between the institution to which the students belong and their evaluation of the online platform.

Table 79. *Measures of Association-the E-learning Platform and Public/Private Sector*

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,319	,000
	Cramer's V	,319	,000
N of Valid Cases		228	

To obtain accurate measurements and to identify the strength of this relationship we used Cramer's V coefficient of association. As indicated in the above table 79, the result of the test equals 0.319 with a *p*-value of .000, which means that there exist a weak association between the private/public sector and students' evaluation of the e-learning platform. In other words, students from both private and public institutions give similar ratings to the e-learning platforms as shown in the bar graph below

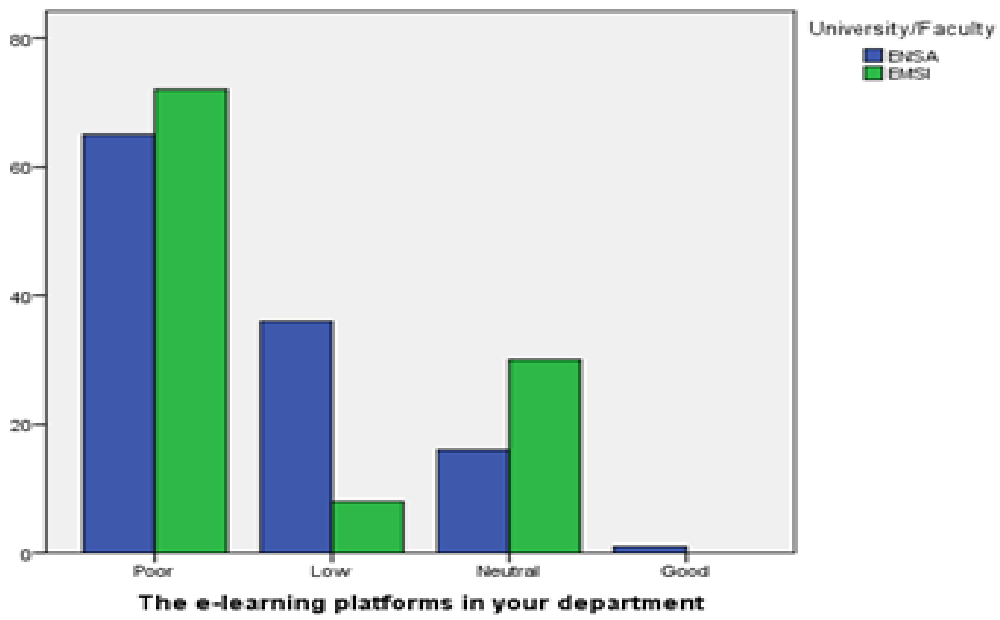


Figure 47. Evaluation of the E-Learning Platform of the Institution in Relation to Public/Private Sector

3.1.11.4. Evaluation of the E-learning Center

As already mentioned in chapter one, an e-learning center is a center where teachers are able to access materials on the website. It offers ongoing workshops and training for instructors, and tracks thoroughly their contribution in enhancing the e-learning contents (Shraim, 2018). "An e-learning center can also include the support to innovate, research, explore, and promote excellence in teaching and learning with diverse technologies" (Repetto & Trentin, 2011, as cited in Thornton & Koech, 2017, p.75). In order to determine students' attitudes towards the e-learning center, we first asked them if they have one in their institution.

Table 80. *Correlation between the Presence of an E-learning Center and the Private/Public Sector*

The Presence of an E-learning Center* University/School Cross-tabulation

		University/School		
		ENSA	EMSI	Total
Is there any e-learning center in your institution?	Yes	0	0	0
	No	0	0	0
	Total	118	110	228

Table 80 shows that all the respondents provided a "no" answer to this question. This means that both research sites do not possess an e-learning center.

Table 81. *Results of Chi-square Test* of Association *between the Presence of an E-learning Platform and Public/Private Sector*

Chi-square Tests

	Value
Pearson Chi-square	.[a]
N of Valid Cases	228

a. No statistics are computed because (is there any e-learning platform in your institution?) is a constant.

Table 82. *Measures of Association between the Presence of an E-learning Platform and Public/Private Sector*

Symmetric Measures

		Value
Nominal by Nominal	Phi	.[a]
N of Valid Cases		228

a. No statistics are computed because (is there any e-learning platform in your institution?) is a constant.

The presence of an e-learning center in both institutions is considered a constant by the SPSS software, as it counted the same modality for all the observations of the sample. This explains the null result of the Chi-square test and the Cramer's V coefficient. In short, the evaluation of the private and public sector effort in terms of an e-learning center is the same, simply because respondents in both research sites provided the same answer to that question, which is a no answer. The bar chart below depicts the evaluation of the e-learning center according to both public and private sectors.

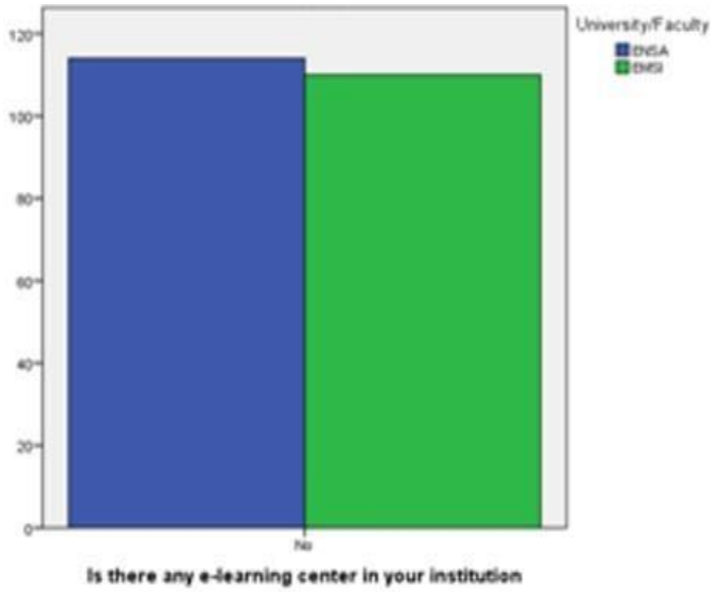


Figure 48. *Evaluation of the E-learning Center in Relation to the Public/Private Sector*

3.1.11.5. Evaluation of the Interactive Whiteboard

Regarding the evaluation of the interactive whiteboard, we notice that there is no big difference between the answers provided by public and private students. The majority of respondents attributed a negative evaluation to the efforts made by their institutions concerning the smart board.

Table 83. *Correlation between the Interactive Whiteboard and the Private/Public Sector*

The Interactive Whiteboard * University/School Cross-tabulation

		University/School		
		ENSA	EMSI	Total
The smart board	Poor	89	60	149
	Low	25	39	64
	Neutral	4	11	15
Total		118	110	228

Table 84. *Results of the Chi-square Test of Association between the Interactive Whiteboard and Public/Private Sector*

Chi-square Tests

	Value	Df	Approx. Sig. (2-sided)
Pearson Chi-square	11,421[a]	2	,003
Likelihood Ratio	11,598	2	,003
Linear-by-linear Association	11,183	1	,001

N of Valid Cases	228		

a. 0 cells (0, 0%) have an expected count less than 5. The minimum expected count is less than 7, 27.

According to the result of the Chi-square test (Sig=0,003 < 0,005), there is certainly a relationship between the two variables. However, Cramer's V coefficient (see table 85 below) demonstrates that the degree of association is weak since the coefficient value of the test does not exceed 22, 4%. The bar chart 49 below, summarizes the evaluation of the interactive whiteboard according to the public and private sectors.

Table 85. *Measures of Association-the Interactive Whiteboard and Public/Private Sector*

Symmetric Measures

		Value	Approx. Signification
Nominal by Nominal	Phi	,224	,003
	Cramer's V	,224	,003
N of Valid Cases		228	

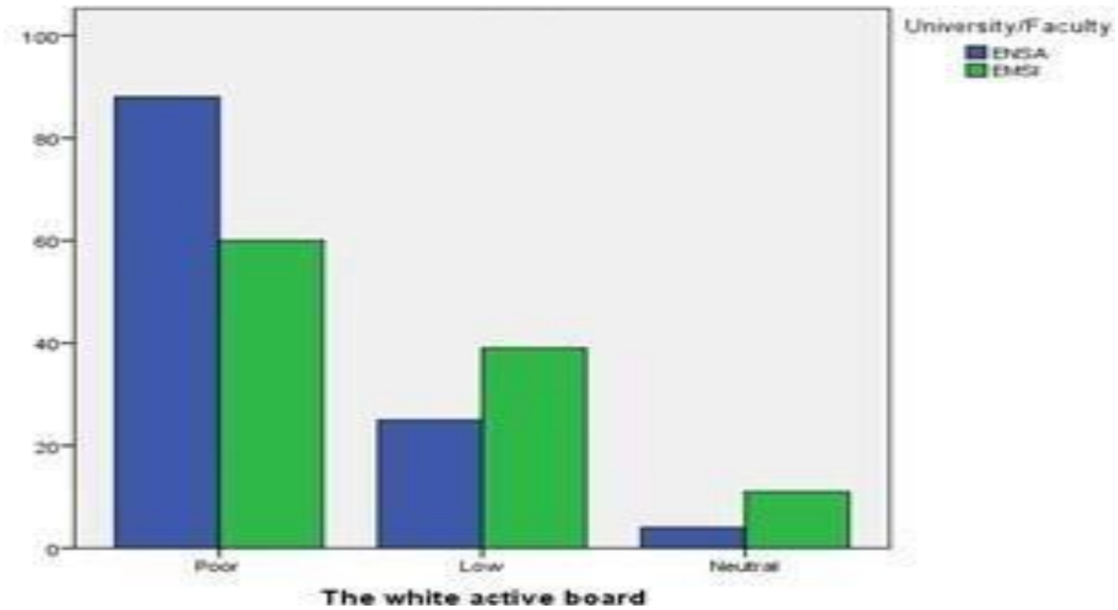


Figure 49. *Evaluation of the Interactive Whiteboard in Relation to the Public/Private Sector*

3.1.12. Factors Promoting the Use and Adoption of E-learning Systems

This section tends to identify according to the students, the factors that promote the use and adoption of e-learning in higher education institutions (HEIs). Therefore, the last research question in this study investigates the various factors that promote the successful integration of e-learning in Moroccan higher engineering education.

- RQ 10: What are the factors affecting the adoption of e-learning technology in learning engineering higher education?

To answer this question, the students' questionnaire included a five-point Likert type-rating scale on which the participants were asked to rate the importance of the factors that may promote the use of e-learning in learning engineering. For this reason, the researcher selected nine explanatory variables of this research construct (the successful integration of e-learning), from which we notice strong bilateral correlations as seen in the following table (86):

Table 86. *Summary Results of a Multivariate Analysis Relating Different Variables*

Correlations

Dimension : 1

	Availability of internet	Student's commitm-ent	trainings for teachers	security for e-learning platform	Diversity of e-courses tasks	Technical support	Students' awareness	Financial ressources	Students' trainings
*Availability of the internet connection	1,000	,181	,430	,302	,601	,481	,098	,268	,428
*Student's commitment[a]	,181	1,000	,240	,346	,227	,249	,284	,422	,305
*Updating trainings for university teachers[a]	,430	,240	1,000	,213	,686	,926	,368	,277	,945
*High level of security for the e-learning platform[a]	,302	,346	,213	1,000	,193	,243	,189	,218	,276
*Diversity of the e-courses tasks and activities[a]	,601	,227	,686	,193	1,000	,667	,369	,331	,664
*Availability of technical support[a]	,481	,249	,926	,243	,667	1,000	,268	,331	,936
*Students awareness of the importance of technology in education	,098	,284	,368	,189	,369	,268	1,000	,416	,324
*Finacial ressources and budget[a]	,268	,422	,277	,218	,331	,331	,416	1,000	,307
*Students accurate trainings[a]	,428	,305	,945	,276	,664	,936	,324	,307	1,000
Dimension	1	2	3	4	5	6	7	8	9
Valeur propre	4,367	1,360	,963	,765	,659	,497	,277	,063	,048

a. Group

The most important association is the one that brings together the training of students and that of teachers with a coefficient value equal to 0, 945. This means that updating training sessions for teachers in terms of e-learning has a 94.5% impact on the quality of students' training. The second association also relates to the issue of updating teachers' training programs in the field of e-learning, but this time, depending on 92.6% of the availability of technical support. While the third association is between the level of training sessions offered to students and the availability of technical support dedicated to the integration of e-learning in the engineering departmens; the dependency between these two variables is 93.6%. In this case, we can say that the training sessions dedicated to students depend primarily on the availability of technical support. The fourth association is also related to the teachers' training, a 69% of dependency exists between the implementation of training sessions dedicated to teachers and the diversity of courses, activities and assignments which they can offer to their students.

The availability of the technical support, according to table 86, does not only impact the training of teachers and students but also the diversity of pedagogical content offered in the e-learning environment with a correlation coefficient value equal to 0, 667, which is said to be strong and positive. Eventually, the last significant association that appears in the same table is the one that links the diversity of educational content and the quality of training programs offered to students; a 0.644 correlation coefficient indicates that there is absolutely an interdependence relationship between the two variables. That is to say that 66.4% of the quality of the training offered to students relates to the diversity of the educational content put in place, and vice versa.

Cronbach's Alpha test as part of the (MCA) analysis allows us to verify whether all the explanatory variables do indeed contribute to the explanation of the research construct. The results show that the nine explanatory variables were reduced and classified into two principal groups of variables called dimensions (See table 87 below). We obtained an alpha value equal to 0.868 for the first dimension and an alpha value equal to 0.821 for the second dimension. This means that the first dimension contributes up to 86, 8% to the explanation of the research construct (successful integration of e-learning), and the second dimension can explain up to 82, 1% of the research construct. The purpose of these measures is to identify the elements (variables) that belong to each of the two dimensions 1 and 2.

Table 87. *Cronbach's Alpha Test*

Model Summary

Dimension	Cronbach's Alpha	Explained Variance	
		Total (Eigenvalue)	Inertia
1	,868	4,372	,486
2	,821	3,700	,411
Total		8,072	,897
Average	,846[a]	4,036	,448

a. The Average Cronbach's Alpha value is based on the average eigenvalue.

The ultimate goal of the (MCA) is to reduce the number of explanatory variables into two main explanatory dimensions, as shown in table 88 and figure 50 below.

Table 88. *Results of the Measures of Discrimination*

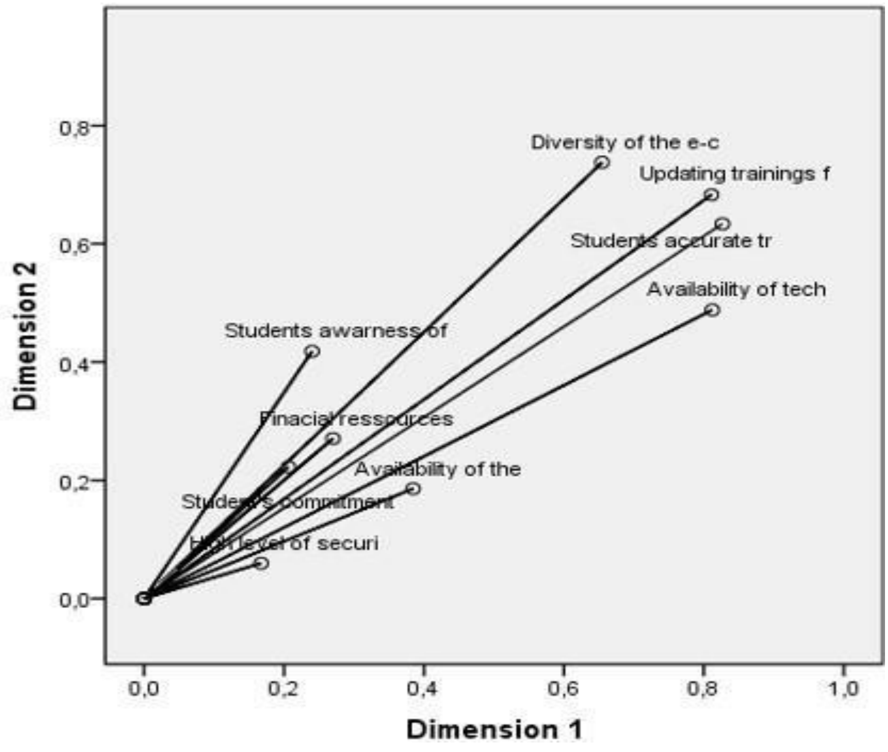
Discrimination Measures

	Dimension		
	1	2	Mean
*Availability of the internet connection	,384	,186	,285
Student's commitment	,206	,223	,215
*Updating trainings for university teachers	,811	,683	,747
*High level of security for the e-learning platform	,167	,060	,113
*Diversity of the e-courses tasks and activities	,655	,738	,696
*Availability of technical support	,812	,488	,650
*Students awareness of the importance of technology in education	,240	,418	,329
*Financial resources and budget	,270	,271	,270
*Students accurate trainings	,827	,634	,730
Active Total	4,372	3,700	4,036

From the map of discrimination measures below (figure 50), we can easily notice that the variables that explain most of the research construct (the successful integration of e-learning) are:

- The diversity of courses and activities (which belongs more precisely to dimension 2 with a margin of explanation of 74% against only 65.5% on dimension 1).
- As for dimension 1, we have the three remaining variables, namely "students' accurate trainings" with 82.7% of contribution, "availability of technical support" with 81.2% of explanation, and "updating training programs for university teachers" with 81.1% of explanation.

To summarize, facilitating the integration and adoption of e-learning in engineering departments depends on two dimensions. The first dimension relates to the upgrading of material (technical support) and human resources (training of professors and students). The second dimension is related to the diversity of the pedagogical content in terms of the courses and activities offered.



Discrimination Measures

Figure 50. *Plot of Discrimination Measures*

Chapter Four: Presentation of Findings and Data Analysis of the Web-Based Survey and the Semi-Structured Interview

Introduction

One of the major goals of this dissertation is to examine the manifestation of e-learning in the Moroccan higher educational system. In this regard, Clark (2000) asserts that integrating a particular educational project is principally supported by educators' knowledge, tendency, and approach. Thus, to examine the adoption of e-learning in educational settings, attitudes of practitioner teachers should be the first element to take into account. Teachers believe in the valuable role technology plays in today's era, where e-learning is becoming a significant tool that enhances students' learning outcomes and performances. However, some teachers feel uncertain and worried due to the drastic negative impact technology can have on audience, children and youth in particular (Cheung & Xu, 2016). Therefore, this dissertation conducted an online survey as well as a semi-structured interview with university teachers aiming at gathering a wide range of their perceptions of the integration of e-learning in higher engineering education.

This chapter is divided into two sections; the first section presents the findings of the web-based survey questionnaire, while the second one establishes the findings of the semi-structured interview. For the online questionnaire, the SPSS was adopted for a statistical analysis of the quantitative data. As far as the interview is concerned, a thematic content analysis method was used to categorize and interpret the qualitative data.

Section One: Presentation of Findings and Data Analysis of the Web-Based Survey

4.1. Findings of the Teachers' Survey

To examine the adoption of ICT and e-learning tools in higher engineering education, attitudes of practitioner teachers should be an important element to take into consideration. Thus, this paper conducted a survey with 80 university teachers from public and private institutions namely ENSA and EMSI respectively. The next section, then, reports the results of the online questionnaire administered to the teachers. First, a demographic description of the respondents' profile is given, succeeded by a statistical analysis of the main survey's questions.

The findings are presented in graphs and tabulations in order to ensure clarity and a sufficient degree of comprehensiveness.

4.1.1 Description of Respondents

This section first offers an overview of the varied background information of the participants who were involved in this study and filled out the online questionnaire before examining the data on their perceptions and attitudes towards e-learning integration in education. As stated earlier, the web-based questionnaire comprised two pages of detailed closed and open questions and was written in French and then translated into English since not all of the respondents can speak, write and understand the language. The questionnaire was sent via electronic mail to 100 teachers from two Moroccan public and private higher engineering institutions ENSA & EMSI respectively during the months of February and March 2017. The institutions were both located in the Moroccan city of Marrakech. A total of 80 surveys were retrieved which combines 80% response rate, which reveals that the sample size is still functional to be representative for the population. Figure 51 below is a bar chart that shows the distribution of teachers according to the research sites:

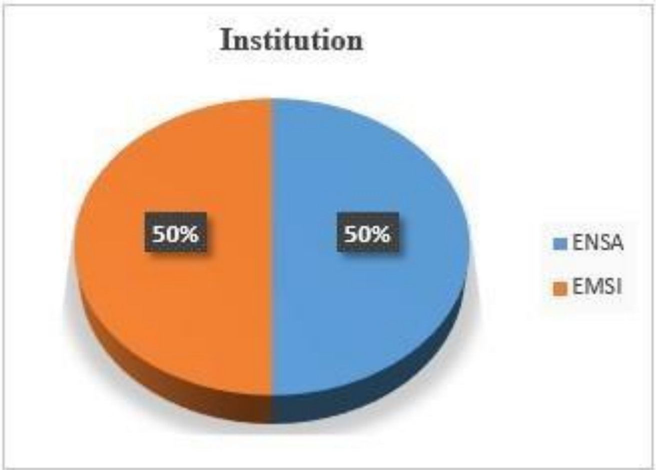


Figure 51. *Distribution of Respondents by Institution*

The total number of participants involved in this research was 80; they were distributed in similar frequencies among the research sites.

4.1.1.1. Number of Respondents by Sex

Table 89. *Distribution of Frequency and Percentage for Respondents Gender*

What is your Sex? Male or Female

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	53	66,3	67,9	67,9
	Female	25	31,3	32,1	100,0
	Total	78	97,5	100,0	
Missing	System	2	2,5		
Total		80	100,0		

The first question that the participants were asked is to identify their gender. From table.89, it appears that the majority of the participants in this survey were males 67, 9% (N=53) whereas females were less in number (N=25), they represent 32, 1% of the sample size.

4.1.1.2. Respondents' Age

Table 90. *Distribution of Frequency and Percentage for Respondents Age*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25-35	25	31,3	31,6	31,6
	36-45	17	21,3	21,5	53,2
	46-55	23	28,8	29,1	82,3
	56-65	14	17,5	17,7	100,0
	Total	79	98,8	100,0	
Missing	System	1	1,3		
Total		80	100,0		

The respondents in this research are teachers in higher education institutions, in the survey they were split into different groups; the first group from 25 to 35 years old, the second group from 36 to 45; the third group from 46 to 55, and the fourth group from 56 to 65. Table 90 shows that almost 53.2% (N=42) of the respondents are between 25 and 45 years old in which 31, 6% (N= 25) belongs to the first group and 21.3% (N=17) belongs to the second group. In the third group, there are 23 participants representing 28.8% and finally 14 participants belong to the fourth group, they represent 17.7%.

4.1.1.3. Respondents' Years of Teaching Experience

As for the respondents' years of teaching experience, the groups were divided into three main categories. The first group of respondents having less than ten years of experience represents 28.75%, (N=23) the second group (between 11and 20 years) is the most dominant category with a percentage of 48.75% (N=39), while the third group (21-above) constitutes 22.5% (N=18) of the sample studied.

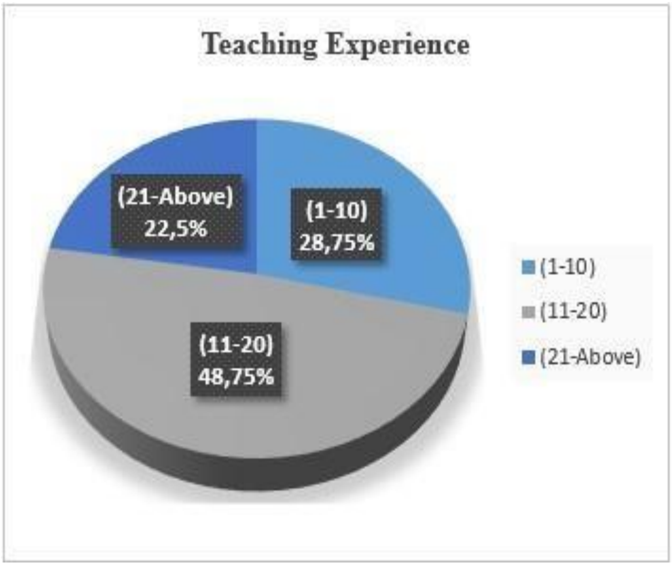


Figure 52. *Distribution of Frequency and Percentage for Respondents' Teaching Experience*

4.1.2. Teachers' Use of Technology

The second section within the online questionnaire was designed to investigate the extent to which the teachers are familiar with technology. Thus, respondents were asked about computers ownership, how often they use them, the time they spend on the Internet, and their comfort level with technology. Teachers' use and access to technology represents a primary factor that would shape their attitudes towards e-learning as well as their willingness and readiness to use it. Therefore, the first research question of the present study examines the different digital skills and tools that the teachers possess and benefit from.

- RQ1: What type of information and communication technologies (ICTs) do the students and instructors possess and benefit from?

4.1.2.1. Computer Ownership

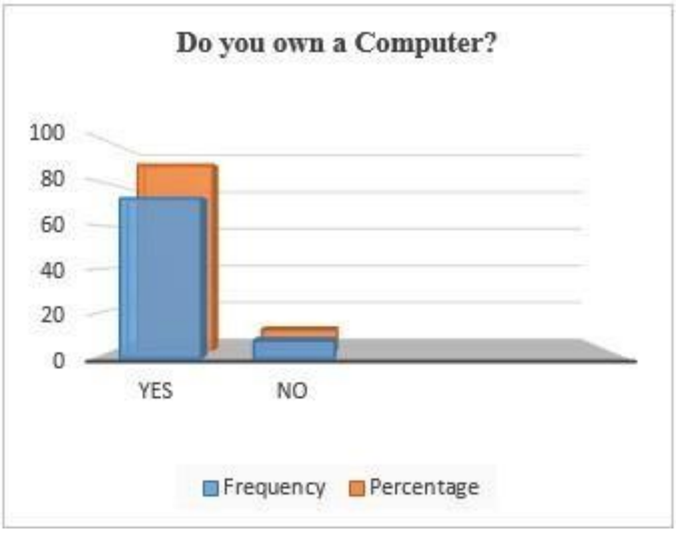


Figure 53. *Computer Ownership for the Respondents*

Among the 80 professors we interviewed, 72 of them do own computers; they represent 90% compared to only 8 participants who claimed not to have a computer or a laptop, a minority of 10% of the overall sample size. Moreover, table 91 shows that the number of teachers who own a computer and teach in the public sector is equal to the number of teachers who teach in the private one and possess a computer. To dig deeper into the relationship between these two variables, we used the chi-square test.

Table 91. *Correlation between Computer ownership and Institution*

Computer Ownership * Institution Cross-tabulation

		Institution		
		ENSA	EMSI	Total
Do you own a computer?	Yes	36	36	72
	No	4	4	8
Total		40	40	80

Table 92. *Chi-square Test for Association*

Chi-square Test

	Value	Df	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1 Sided)
Pearson Chi-square	,000[a]	1	1,000		
Continuity Correction[b]	,000	1	1,000		
Likelihood Ratio	,000	1	1,000		
Fisher's Exact Test				1,000	,644
Linear-by-Linear Association	,000	1	1,000		
N of Valid Cases	80				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 4.00.

As illustrated in table 92, the significance of the test is equal to 0,644 (64, 4%) which is much higher than the tolerated margin of error of only 0.005 (5%). This means that there is no relationship between the two variables. In other words, the possession of a computer by a teacher is not impacted by the school in which the latter teaches.

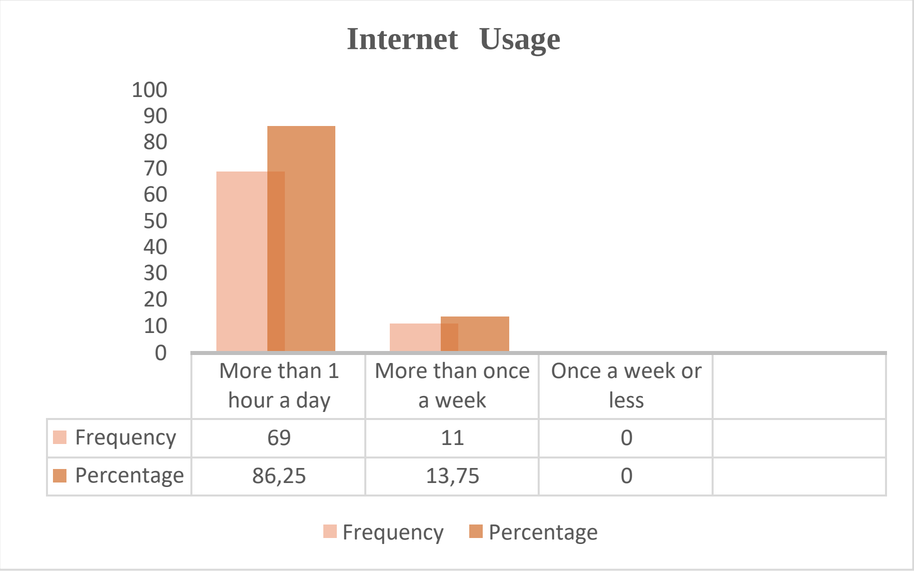
4.1.2.2. Computer Usage

Table 93. *Frequency and Percentage Distribution for Respondents' Frequencies of Computer Usage*

	Frequency	Percent	Valid Percent	Cumulative Percent
Every day	54	69,23	69,23	69,23
A few times a week	13	16,66	16,66	85,89
Occasionally	7	8,97	8,99	94,88
Rarely, if ever	4	5,12	5,12	100,0
Total	78	100,0		

It is worth nothing that 54 from the 78 respondents who responded to this question use their computers on a daily basis; they represent the majority with a percentage of 69.2. On the other hand, 16.66% (N=13) use their computers a few times a week, and 7 participants use them occasionally, while only four participants rarely if ever use their computers; they constitute 5.12%.

4.1.2.3. Internet Usage



	More than 1 hour a day	More than once a week	Once a week or less	
Frequency	69	11	0	
Percentage	86,25	13,75	0	

Figure 54. *Distribution of Frequency and percentage for Respondents' Use of the Internet*

Respondents were also asked how often they use the Internet per week. From their answers depicted in figure 54, we notice that the vast majority 86.25% (N=69) spend more than one hour a day on the Internet, whereas a small portion of respondents 13.75% claim to use the Internet more than once a week; they represent 11 participants. Nonetheless, none of the respondents claims to use the Internet once a week or less.

4.1.2.4 Confidence and Comfort Level with Technology

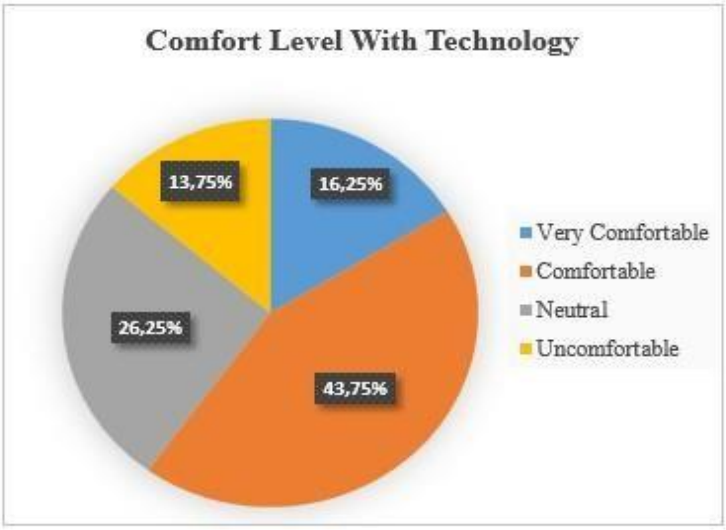


Figure 55. *Distribution of the Respondents Comfort Level with Technology*

In general 60% of the respondents feel comfortable in using technology of which 16.25% (N=13) are very comfortable and 43.75% (N=35) are fairly comfortable. On the other hand, 21 participants were neutral they constitute 26.25% of the sample size, while (13.75%, N=11) feel uncomfortable with technology.

4.1.3. ICT and E-learning Use in Teaching Engineering

As discussed before, e-learning is becoming very common in many countries around the globe, particularly in developed nations. Nonetheless, it is still in its early stages in Morocco. In this work, therefore, the purpose is to examine and evaluate the extent to which e-learning is manifested in Moroccan higher education settings. Thus, the second research question investigates the degree of the teacher’s use of e-learning tools for teaching engineering in (HEIs).

- RQ 2: Do Teachers use ICT and particularly e-learning in the classroom for teaching engineering education?

4.1.3.1. Use of ICT and E-learning Tools

To answer this question, participants were questioned about the different digital tools they use for teaching engineering, how often they use them, whether they have ever heard of an e-learning teaching program and whether they have ever participated in a training program to effectively use technology in class.

First, respondents were asked to identify the type of ICT tools they use in teaching engineering; thus, the following table presents the various tools employed according to the participants in both research sites.

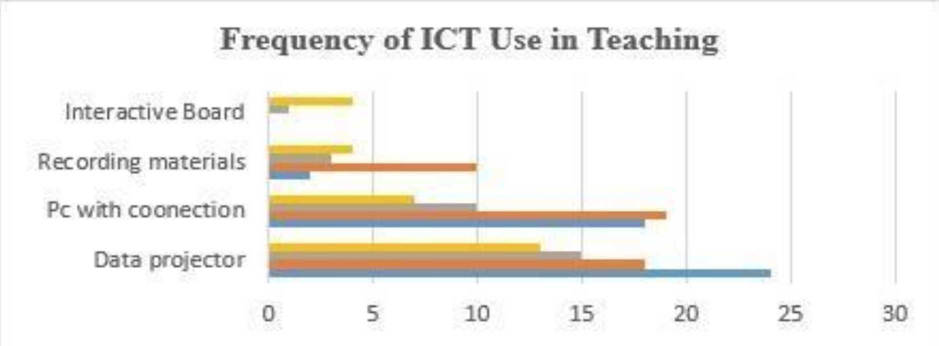
Table 93. *Correlation between ICT Tools and Institution*

ICT Tools * Establishment Cross-tabulation

			Institution		
			ENSA	EMSI	Total
ICT used[a]	Data Show projector	Count	39	31	70
	White board	Count	3	2	5
	Pc with connection	Count	24	27	51
	Recording materials	Count	6	12	18
Total		Count	40	35	75

We notice from the table 93 above that the results are almost similar for both public and private sectors. It can be noted that 70 out of 75 participants report using a data projector for delivering their lessons, while 51 out of 75 use PCs with connection. Regarding the use of the recording materials and the Smart board, 24% (N=18) and 6.66% (N=5) of the respondents use them respectively.

4.1.3.2. Level of ICT Use in Teaching



	Data projector	Pc with coonection	Recording materials	Interactive Board
Rarely	13	7	4	4
Occasionally	15	10	3	1
A few times a week	18	19	10	0
Every day	24	18	2	0

Figure 56. *Respondents' Frequency of ICT Use in the Classroom*

Figure 56 shows that the data projector is the most used tool for delivering the lesson among the teachers. 24 out of the 70 participants who claimed to use the data show projector use it on a daily basis; they represent 34.28%. Concerning the use of computers with connection, 18 out of the 51 respondents who claimed to use these type of devices for teaching use them every day, while those who claimed to use recording materials in delivering their courses, 10 out of them use them a few times a week. Eventually, the respondents who claimed to use the smart board as a learning too, occasionally or rarely include it in their teaching methods; they represent the minority (7%).

4.1.3.3. Familiarity with E-Learning Teaching Programs

Another question that respondents were requested to answer is whether they have ever heard of an e-learning teaching program. Based on the bar graph 57 below, we observe that the vast majority of the respondents (97.43%, N=76) are familiar with the concept of e-learning of which 38 participants belong to the private sector and 38 belong to the public one.

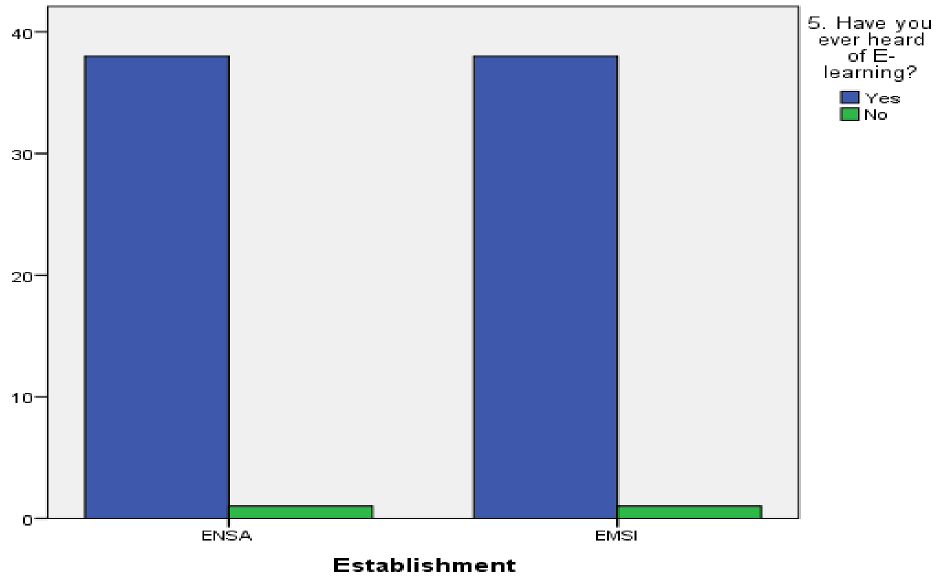


Figure 57. *Distribution of Respondents' Familiarity with E-Learning*

4.1.3.4. Level of Digital Skills

To determine the degree of the teachers' digital skills, respondents were asked if they have ever participated in workshops or seminars that promote their ICT skills, and if they need further training programs to enhance their knowledge and understanding of technology use in teaching. Therefore, the third research question examines the level of the teachers' digital competences, which support the effective and efficient use of e-learning in teaching engineering.

- RQ 3: How skilled are the teachers in using e-learning?

To answer this question, the researcher cross-tabulated the two variables as displayed in table 94 below.

Table 94. *Correlation between the Participation in a Training Program about E-learning Technology and Institution*

Institution * have you ever participated in a training which concerns e-learning technology? Cross-tabulation

		Have you ever participated in a training, which concerns e-learning technology?		
		Yes	No	Total
Institution	ENSA	16	24	40
	EMSI	18	21	39
Total		34	45	79

From the table above, it can be noted that 34 out of the 79 respondents (ENSA=16 and EMSI=18) have already participated in training programs on e-learning technology with a percentage of 43%, while 45 out of 79 have never participated in such a training; they constitute 57% of the sample studied.

Additionally, respondents were asked to evaluate the effectiveness of such a training. The pie chart 58 represents their answers:

Figure 58. *Frequency Distribution of Respondents' Evaluation of the Training Program*

It is worth mentioning that almost all of the respondents who have participated in a training program on educational technology confirm its positive contribution to their digital skills. To demonstrate this, the pie chart above shows that 97.05% (N=33) of the respondents evaluated the training as important, while only 1 participant claimed the opposite representing 2.95%.

4.1.3.5. Teacher Training in Digital Pedagogies

Table 95. *Correlation between the Need for Training Programs and Institution*

Institution * Teachers' Need for Training Cross-tabulation

		Do You Need Further Training?		
		ENSA	EMSI	Total
Institution	Yes	33	30	63
	No	9	7	16
Total		42	37	79

Table 95 clearly demonstrates that the great majority of the respondents from both research sites (79.75%, N=63) show high interest in participating at training programs that equip them with the necessary skills to leverage the current and emerging e-learning tools and enhance their professional practice. While a minority of 20.25% (N=16) are not really interested in such programs.

4.1.4. The Impact of Teachers' Background Variables on their Computing Skills and Use

This section attempts to examine the potential differences among participants' variables regarding the use of technology in education. The fourth research question, therefore, investigates the impact of the teachers' background variables (gender, age, teaching experience, place of work) on their e-learning technology use and skills. To answer this question, we first investigated the impact of respondents' variables on their familiarity with the concept of e-learning.

4.1.4.1. The Impact of Teachers' Background Variables on their Familiarity with E-Learning

- **Impact of Gender**

Table 96 below shows us the correlation between the teachers' gender and their familiarity with e-learning. Based on the results, we notice that the vast majority of the participants both males and females are familiar with the concept. The only difference that attracts our attention is among the respondents who responded "yes", we notice that the number of male respondents is higher than females; this is probably due to the distribution of the sample.

Table 96. *Correlation between Respondents' Familiarity with E-learning and Gender*

Count **Correlations**

		What is your Sex? Male or Female		
		Male	Female	Total
Have you ever heard of an e-learning teaching program?	Yes	51	24	75
	No	1	1	2
Total		52	25	77

To dig even deeper into this relationship of influence, we calculated the Cramer's V coefficient, which gave us a value of 59.9%. Thus, we can say that the association between gender and familiarity with e-learning do exist, but it is a moderate relationship.

Table 97. *Measures of Association-Familiarity with E-learning*Gender*

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	,061	,592
	Cramer's V	,061	,592
N of Valid Cases		77	

- **Impact of Age**

At this stage, the researcher wants to investigate the relationship between the respondents' age variable and their familiarity with e-learning. Accordingly, she first cross-tabulated the two variables.

Table 98. *Correlation between Respondents' Familiarity with E-learning and Age*

Count **Correlations**

		How old are you ?				Total
		25-35	36-45	46-55	56-65	
Have you ever heard of e-learning?	Yes	24	16	22	14	76
	No	1	1	0	0	2
Total		25	17	22	14	78

As table 98 displays, the crosstabulation of the responses does not show a big difference between the modalities of the age variable. This means that almost all respondents of all age categories are familiar with the concept of e-learning. In order to confirm or reject this relationship of influence, the chi-square test of association was adopted (see table 99 below).

Table 99. *Results of Chi-Square Test* of Association-*Familiarity with E-learning*Age*

Chi-square Tests

	Value	Df	Assymp. Sig. (2-sided)
Pearson Chi-square	1,903[a]	3	,593
Likelihood Ratio	2,599	3	,458
Linear-by Linear-Association	1,120	1	,290
N of Valid Cases	78		

b. 4 cells (50, 0%) have an expected count less than 5. The minimum expected count is less than ,36.

It is worth mentioning that we can refer to an association between two variables if the significance of the chi-square test is less than 0.5%. This is not the case here, we have a coefficient value of 59.3%>>>>0.5%, which means that there is no relationship between the age and the respondents' familiarity with e-learning.

- **Impact of the Institution**

Dealing always with the respondents' familiarity with e-learning, this time the researcher wants to find out if this variable is impacted by the private/public sector of the institution. The cross-tabulation below (table 100) shows that the number of the respondents who belong to the private institution and have already heard of e-learning is equal to those from the public sector.

Table 100. *Correlation between Respondents' Familiarity with E-Learning and Institution*

		Establishment		
		ENSA (Public)	EMSI (Private)	Total
Have you ever heard of e-learning?	Yes	38	38	76
	No	1	1	2
Total		39	39	78

Moreover, the chi-square test, (table 101 below), rejects this relationship with a coefficient value equal to 100%, which is much higher than the norm of 0.5%.

Table 101. *Results of the Chi-Square Test of Association-Familiarity with E-learning*Institution*

Chi-square Tests

	Value	Df	Approx Sig. (2-tailed)	Exact Sig. (2-tailed)
Pearson Chi-Square	,000[a]	1	1,000	
Continuity Correction[b]	,000	1	1,000	
Likelihood Ratio	,000	1	1,000	
Fisher's Exact Test				1,000
Linear-by-Linear Association	,000	1	1,000	
N of Valid Cases	78			

- **Impact of the Teaching Experience**

As for the years of the teaching experience, table 102 shows that cross-tabulation of the responses does not show a considerable difference between the categories of the teaching experience variable. This means that almost all the respondents of all categories are familiar with the concept of e-learning. The only difference that attracts our attention is among the respondents who responded "yes", we notice that the number of the respondents who belong to the second category (11-20) represents the highest frequency; this is probably due to the distribution of the sample.

Table 102. *Correlation between Years of the Teaching Experience and Respondents' Familiarity with E-learning*

Count

Correlations

		How long have you been teaching?			Total
		1-10	11-20	21-Above	
Have you ever heard of e-learning?	Yes	21	38	17	76
	No	1	0	1	2

Total	22	38	18		78

In order to confirm or reject this relationship of influence, we used the chi-square test (see table 103 below).

Table 103. *Results of Chi-Square Test* of Association-*Familiarity with E-learning*Teaching Experience*

Chi-square Tests

	Value	Df	Assymp. Sig. (2-sided)
Pearson Chi-square	1,587[a]	3	,622
Likelihood Ratio	2,842	3	,576
Linear-by Linear-Association	1,430	1	,205
N of Valid Cases	78		

In this case, the coefficient value of the test equals 62.2%, which is much higher than the accepted margin of error (0.5%). Thus, we cannot confirm an association between the teaching experience and the respondents' familiarity with e-learning.

4.1.4.2.The Impact of the Teachers' Background Variables on their Attitudes towards the Integration of E-learning in Education

At this stage, the researcher wants to check if there is a relationship between the respondents' attitudes towards the integration of e-learning in engineering education and their gender, age, years of teaching experience and their place of work.

- **Impact of Gender**

The researchers start with the first relationship between the respondents' gender and their attitudes towards the adoption of digital learning in education. She first cross-tabulated the variable in question with the sex of the respondents. Thus, she obtained the following values:

Table 104. *Correlation between Respondents' Attitudes towards E-learning and their Sex*

Count Correlations

		What is your Sex? Male or Female		Total
		Male	Female	
Are you for or against the integration of e-learning in education?	For	38	22	60
	Against	15	3	19
Total		53	25	79

Among the 53 male respondents surveyed, 38 are for the integration of e-learning in education, compared to 15 respondents who are against its use for educational purposes. Nevertheless, among the 25 female respondents surveyed, 22 show a positive attitude towards e-learning, while only 3 claim the opposite. From these first results, we can see that there is a difference in terms of respondents' attitudes and their gender. To confirm this relationship, the chi-square test was used.

Table 105. *Results of Chi-Square Test* of Association-*Attitudes towards E-learning*Gender*

	Value	Df	Approx Sig. (2 sided)
Pearson Chi-square	8,277[a]	1	,004
Continuity Correction[b]	6,730	1	,009
Likelihood Ratio	10,288	1	,001
Fisher's Exact Test			
Linear-by-Linear Association	8,171	1	,004
N of Valid Cases	79		

According to table 105, we obtain a coefficient value of 0.004 < 0.005. This means that there is indeed a relationship between these two variables. However, in order to determine whether it is a strong or a weak association, the researcher used the Cramer's V test of association which according to table 106 shows us a coefficient of 51.4% (<70%), which means that the relationship between the respondents' attitudes and their sex is moderate.

Table 106. *Measures of Association-Attitudes towards E-learning*Gender*

Symmetric Measures

		Value	Approx Sig.
Nominal by Nominal	Phi	-,326	,514
	Cramer's V	,326	,004
N of Valid Cases		79	

- **Impact of Age**

Next, we cross-tabulate the respondents' attitudes towards e-learning variable with their age. Based on the findings below, we notice that the respondents who are for e-learning integration are more numerous than those who are not and this for all age categories.

Table 107. *Correlation between Respondents' Attitudes towards E-learning and Age*

Count **Correlations**

		How old are you?				
		25-35	36-45	46-55	56-65	Total
Are you for or against the integration of e-learning?	For	21	14	15	10	60
	Against	4	3	8	4	19
Total		25	17	23	14	79

At this stage, we can neither confirm nor definitively reject this relationship. We first need to check the coefficient value of the chi-square test. The latter equals 41% (see table 108), which is much higher than 0.5%, which means that there is no association between the respondents' attitudes and their age.

Table 108. *Results of Chi-Square Test* of Association-*Attitudes towards E-learning*Age*

	Value	Df	Approx Sig. (2 sided)
Pearson Chi-square	8,277[a]	1	,411
Continuity Correction[b]	6,730	1	,413
Likelihood Ratio	10,288	1	,171
Fisher's Exact Test			
Linear-by-Linear Association	8,171	1	,173
N of Valid Cases	79		

- **Impact of Institution**

Table 109. *Correlation between Respondents' Attitudes and Institution*

		Establishment		Total
		ENSA	EMSI	
Are you for or against the integration of e-learning in education?	For	32	28	60
	Against	8	11	19
Total		40	39	79

From the cross-tabulation responses (table 109), we notice that 32 among the 60 respondents who are for e-learning integration belong to the public sector (ENSA) and 27 respondents belong to the private one (EMSI). The values being very close cannot indicate a possible relationship. However, in order to disprove this relationship, the researcher used the chi-square test (table 110 below). The significance value is 1.68% >> 0.05%. This means that the respondents' attitude does not depend on the private/public sector of the institution.

Table 110. *Results of Chi-Square Test* of Association-*Attitudes towards E-learning*Institution*

	Value	Df	Approx Sig. (2 sided)
Pearson Chi-square	1,903[a]	1	,168
Continuity Correction[b]	1,630	1	,264
Likelihood Ratio	1,348	1	,166
Fisher's Exact Test			
Linear-by-Linear Association	1,879	1	,170
N of Valid Cases	79		

a. 0 cells (00, 0%) have an expected count less than 5. The minimum expected count is less than 9,38.

b. Computed only for a 2x2 table

- **Impact of the Teaching Experience**

As table 111 demonstrates, cross-tabulation of the responses does not show a difference between the categories of the teaching experience variable. This means that almost all the respondents of all categories are for the integration of e-learning in education. The only difference that attracts our attention is among the respondents who responded "for", we notice that the number of the respondents who belong to the second category (11-20 years) of the teaching experiences represents the highest frequency; this is probably due to the distribution of the sample since they represent 48.75% of the sample size.

Table 111. *Correlation between Years of the Teaching Experience and Respondents' Attitudes Towards E-learning Integration in Education*

Count **Correlations**

		How long have you been teaching?			Total
		1-10	11-20	21-Above	
Are you for or against e-learning Integration?	For	19	29	12	60
	Against	4	9	6	19
Total		23	38	18	79

In order to confirm or reject this relationship of influence, the chi-square test of association was adopted. In this case, the significance value is 1.68% >> 0.05%. This means that the respondents' attitude does not depend on their years of teaching experience.

Table 112. *Results of Chi-Square Test of Association-Attitudes towards E-Learning*Teaching Experience*

	Value	df	Approx. Sig. (2 sided)
Pearson Chi-square	2,876[a]	3	,411
Likelihood Ratio	2,864	3	,413
Linear-by-Linear Association	1,870	1	,171
N of Valid Case	79		

4.1.4.3. Impact of Respondents' Variables on Participation in Training Programs

After dealing with the impact of the respondents' variables on their familiarity with e-learning, the researcher is interested in the respondents' participation in training programs concerning e-learning in relation to their sex, age, teaching experience and place of work.

- **Impact of Gender**

The researcher starts with the first relationship between the respondents' gender and their participation in training programs. The cross-tabulation findings (see table 113 below) show a considerable difference between the male teachers who have already benefited from a training program with a frequency of 24 (30.7%), while only 9 female respondents (11.53%) have been able to benefit from a training dedicated to the use of e-learning in education.

Table 113. *Correlation between Age and Participation in Training Programs*

Count Correlations

		What is your Sex? Male or Female		
		Male	Female	Total
Have you ever participated in a training about e-learning technology?	Yes	24	9	33
	No	29	16	45
Total		53	25	78

Given that the sample surveyed is composed of more males than females, we cannot confirm this relationship through cross-tabulation findings alone. To do this, we used the chi-square test to test the relationship between two qualitative variables.

Table 114. *Results of the Chi-Square Test of Association-Gender*Participation in Training Programs*

	Value	df	Approx Sig. (2 tailed)
Pearson Chi-square	,600[a]	1	,439
Continuity Correction[b]	,280	1	,597
Likelihood Ratio	,605	1	,437
Fisher Exact Test			
Linear-by-Linear Association	,592	1	,442
N of Valid Cases	78		

The chi-square test shows us a coefficient value of 43.9%, which is higher than 0.5%. This result rejects the relationship between the respondents' gender and the fact of participating in a training program on e-learning technology.

- **Impact of Age**

To detect a possible relationship between the respondents' age variable and their participation in a training program on e-learning technology, the researcher first cross-tabulated the two variables.

Table 115. *Correlation between Respondents' Age and Participation in Training Programs*

Count Correlations

		How old are you?				Total
		25-35	36-45	46-55	56-65	
Have you ever participated in a	Yes	9	6	9	10	34

training on e-learning technology?	No	16	11	14	4	45
Total		25	17	23	14	79

From table 115, we notice that for all age groups, the number of participants who have never benefited from such training exceeds the number of participants who have already participated in such event. However, the cross-tabulation is not sufficient to detect an association between the two variables; therefore, the chi-square test was adopted.

Table 116. *Results of Chi-Square Test of Association-Participation in Training Programs *Age*

Chi-Square Tests

	Value	Df	Approx Sig. (2 tailed)
Pearson Chi-square	5,667[a]	3	,129
Likelihood Ratio	5,695	3	,127
Linear-by-linear Association	3,275	1	,070
N of Valid Cases	79		

a. 0 cells (0,0%) have an expected count less than 5. The minimum expected count is less than 6,03.

The chi-square test gives us a coefficient value of 12.9%, which is higher than 0.5%. Accordingly, we can say that no relationship is confirmed between the respondents' age and the fact they have benefited from a training program or not.

- **Impact of Institution**

To detect a possible relationship between the respondents' participation in training programs on e-learning technology and the public or private sector they belong to, theresearcher cross-tabulated the two variables.

Table 117. *Correlation between Respondents' Place of Work and Participation in Training Programs*

Count Correlations

		Establishment		Total
		ENSA	EMSI	
Have you ever participated in a training on e-learning technology?	Yes	16	18	34
	No	24	21	45
Total		40	39	79

Based on the cross tabulation findings, we have 16 respondents from the public school (ENSA) who have benefited from such training, and 18 from the private school (EMSI) who have also benefited from this type of training. The respondents who claim the opposite are distributed as follows, 24 respondents from the public sector, and 21 from the private sector. For both cases (yes and no), the frequencies are very close, so based on these initial results we cannot say that a relationship exists between the variables. Thus, the chi-square test was used. The results of the test (see table 118) show that there is no association between these two variables with a coefficient value of 58.1%.

Table 118. *Results of Chi-Square Test* of Association-*Participation in Training Programs * Public/Private Sector*

	Value	Df	Approx. Sig (2 sided)
Pearson Chi-square	,305[a]	1	,581
Continuity Correction[b]	,106	1	,745

Likelihood Ratio	,305	1	,581
Fisher Exact Test			
Linear-by-Linear Association	,301	1	,583
N of Valid Cases	79		

- **Impact of the Teaching Experience**

Table 119. *Correlation between Respondents' Years of Teaching Experience and their Participation in Training Programs*

Count **Correlations**

		How long have you been teaching?			Total
		1-10	11-20	21-Above	
Have you ever participated in a training on e-learning?	Yes	10	18	6	34
	No	13	20	12	45
Total		23	38	18	79

As demonstrated in table 119, cross-tabulation of the responses shows a significant difference between the categories of the teaching experience variable. We find that respondents belonging to the second category (11-20) are the ones who participated most in training programs on e-learning, they represent 52.95% (N=18), followed by respondents belonging to the first category (1-10) (29.42%) and those belonging to the third category (21-above) they constitute 17.65%. However, we cannot confirm this possible relationship based only on the cross-tabulation findings. Therefore, the chi-square test of association was adopted.

Table 120. *Results of Chi-Square Test* of Association-*Participation in Training Programs *Teaching Experience*

Chi-Square Tests

	Value	Df	Approx Sig. (2 tailed)
Pearson Chi-square	5,667[a]	3	,004
Likelihood Ratio	5,695	3	,009
Linear-by-linear Association	3,275	1	,003
N of Valid Cases	79		

According to table 120, we obtain a significance value of 0.004, which is lower than the accepted margin of error 0.005. This means that there is indeed a relationship between these two variables. In other words, the respondent's participation in a training program on e-learning is conditioned by his/her years of the teaching experience.

4.1.5. Teachers' Perceptions and Attitudes towards The Use of E-learning in Higher Engineering Education

4.1.5.1. Teachers' Attitudes towards the Integration of E-learning in Class

The trend of adopting e-learning as a teaching tool nowadays is becoming very common all over the world. Many institutions of higher education are resorting to e-learning in the provision of enhanced learning. However, we cannot refer to a successful and efficient e-learning environment without the teachers' willingness and readiness to embed and adopt e-learning in their teaching practices. In fact, the teachers' attitudes are a critical factor that influences the integration of e-learning in education (Zhang, 2011). Therefore, this section attempts to answer the fifth research question that examines the teachers' attitudes and perceptions towards e-learning as a teaching assisted tool in teaching engineering higher education.

- RQ5: How do college teachers perceive e-learning technology in teaching higher engineering education?

In order to answer this question, respondents were first questioned on their attitudes towards integrating e-learning in education.

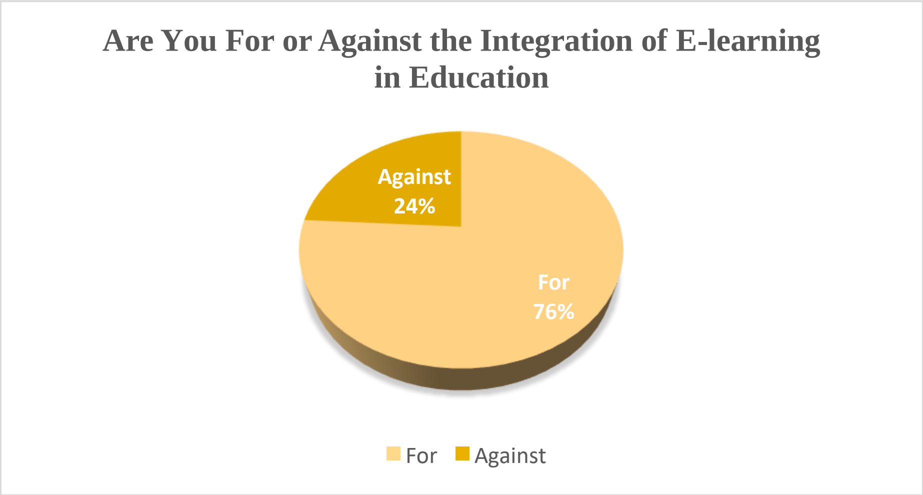
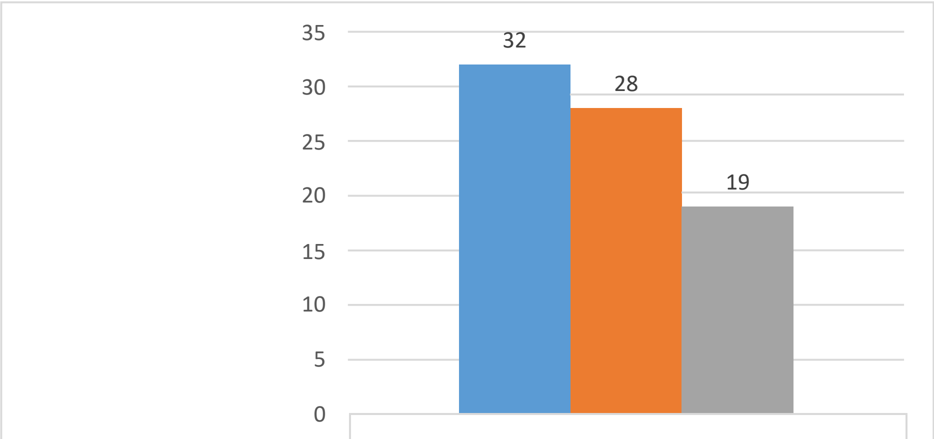


Figure 59. *Teachers' Attitudes towards E-Learning*

The pie chart shows that the vast majority of respondents (N=60) are for the integration of e-learning in teaching engineering, they represent 76%. However, only 19 respondents are against its adoption in education; they constitute 24%. In other words, teachers tend to have positive attitudes towards e-learning.

Moreover, respondents were also asked how effective is e-learning compared to traditional classroom based learning, the following figure represents their answers:



E-learning is more effective	32
Both are the same	28
Traditional class based learning is better	19

Figure 60. *Respondents Attitudes towards the Effectiveness of E-learning*

From figure 60 above, 32 respondents believe that the use of e-learning in teaching engineering is more effective than conventional learning, they represent 40.5%, while 35.44% (N=28) find that both e-learning and traditional classroom instruction have the same effectiveness. On the other hand, 24.0 per cent of minority respondents (N=19) consider face-to-face modes of teaching better than digital learning.

Additionally, respondents were requested to evaluate their students' attitudes towards the integration of e-learning in education. Therefore, table 121 presents the main responses.

Table 121. *Teachers' Evaluation of Students' Awareness towards E-learning in Education*

		Frequency	Percentage	Valid Percent	Cumulative Percent
Valid	Aware	44	55,0	60,3	60,3
	Little conscious	25	31,3	34,2	94,5
	Unconscious	4	5,0	5,5	100,0
	Total	73	91,3	100,0	
Missing	System	7	8,8		
Total		80	100,0		

Based on the results, 60.3% (N=44) of the respondents believe that the students are aware of the importance of e-learning , 34.2% (N=25) think that the learners are little aware while only 5.5% (N=4) suppose that students are unaware of the significance of using e-learning in education. The following figure (61) provides the respondents' evaluation based on the public/private sector of the institution.

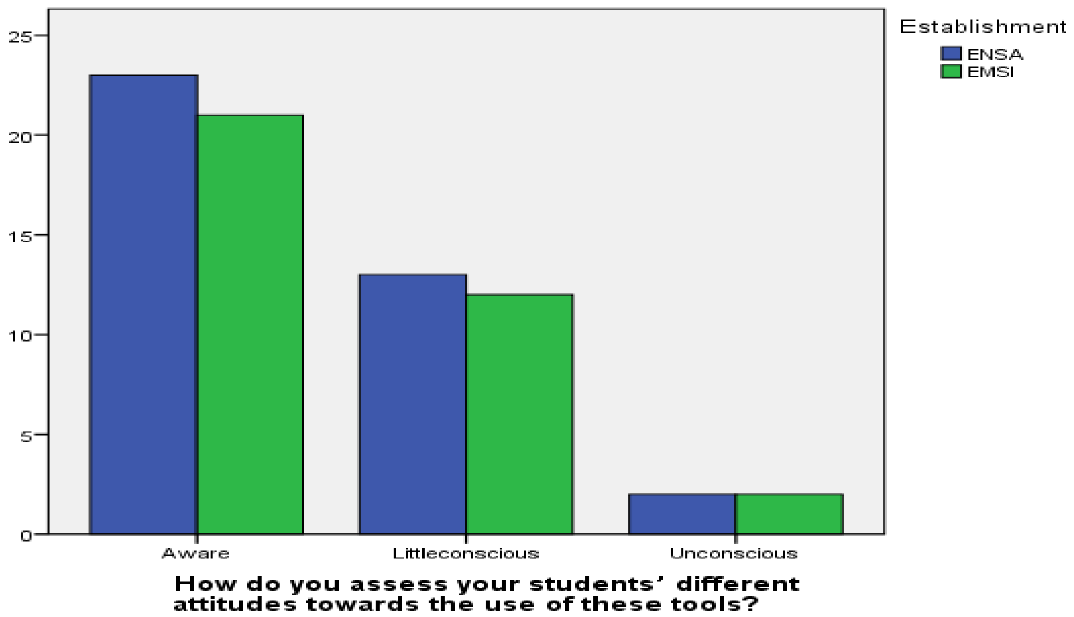


Figure 61. *Students' Awareness towards E-Learning According to Teachers*

At this stage, the researcher asked the respondents if they have ever tried to help students be aware of the importance of e-learning technology and understand its role. The bar graph (see figure 62) presents the responses of the respondents from both private and public sectors.

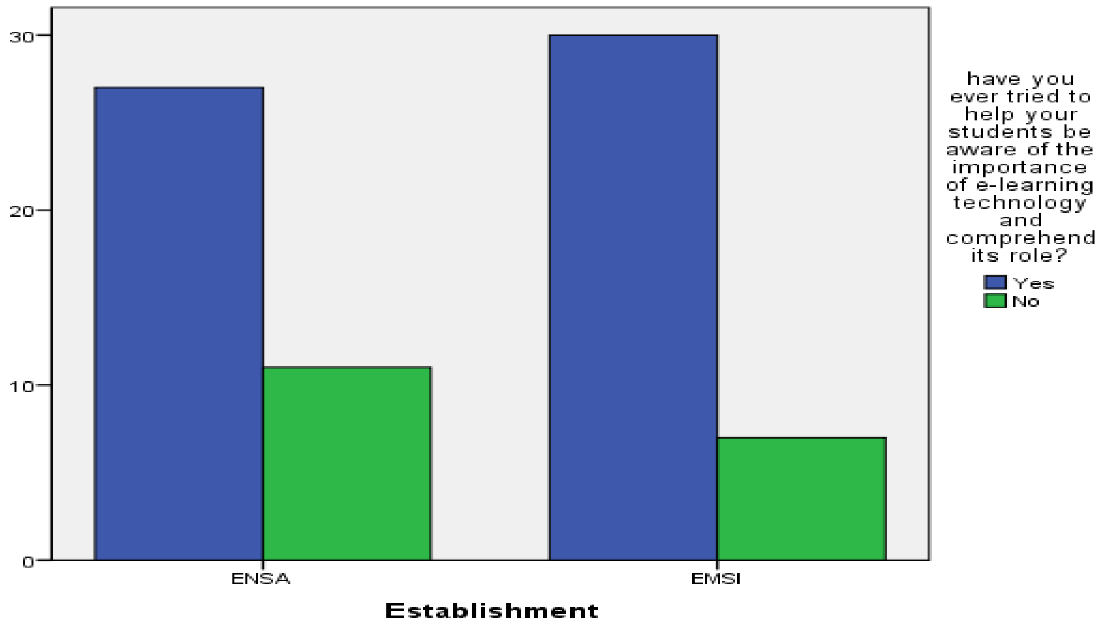


Figure 62. *The Impact of Teachers on Students' Attitudes towards the Importance of E-learning*

From the bar graph, we notice that the respondents' responses are so close. The vast majority of the respondents belonging to both research sites (ENSA=27, EMSI=30) claimed that they helped their students become aware of the importance of e-learning in education, they represent 76%. On the other hand, 24% (N=11+7) claimed the opposite.

In addition to that, the researcher wanted to verify if there is a relationship between the respondents' attitudes towards e-learning integration in education and the fact that they help their students in becoming aware of the importance of e-learning technology in class. In order to answer this question she cross-tabulated the two variables.

Table 122. *Correlation between Teachers' Attitudes towards E-learning and their Impact on Students' Awareness*

Teachers' Attitudes * Impact on Students Awareness Cross-tabulation

		Have you ever tried to help your students be aware of e-learning techno		
		Yes	No	Total
Are you for or against the integration of e-learning technology	For	57	3	60
	Against	0	18	18
Total		57	21	78

As displayed in table 122, we notice that almost all of the respondents who are for the integration of e-learning help their students become aware of its importance. For instance, the highest number of those who answered "for" for e-learning integration (N=57) are themselves who answered "yes" for raising their students' awareness towards e-learning technology. On the other hand, we notice that all of the respondents who are against the use of e-learning in the classroom (N=19) never tried to raise their students' consciousness of the role of e-learning. Besides, in order to determine the degree to which both variables associate or covary, the researcher used the Chi-square test of association. As indicated in table 123 below, the significance of the test is equal to 0.000 which is much lower than 0.005, confirming the existence of a mutual influence between the two variables.

Table 123. *Results of Chi-square Test* of Association-*Teachers' Attitudes*Impact on Students' Awareness*

Chi-square Tests

	Value	Df	Assymp. Sig. (2-sided)
Pearson Chi-square	54,098[a]	1	,000
Likelihood Ratio	12,543	1	,000
Linear-by Linear-Association	15,87	1	,000
N of Valid Cases	78		

c. 2 cells (20, 0%) have expected count less than 5. The minimum expected count is less than ,46.

4.1.5.2. Teachers' Perceived Benefits of E-Learning

After examining the teachers' attitudes and perceptions towards the use of e-learning in teaching and learning engineering, this section deals with the benefits of digital learning as perceived by Teachers. Accordingly, this section aims to answer the sixth research question that examines the perceived advantages of integrating e-learning in tertiary engineering institutions.

- RQ6: What are the perceived educational benefits and opportunities of implementing e-learning technology in teaching and learning higher engineering education?

To answer this question, respondents were given the opportunity through an open-ended question to express in their own terms the benefits of integrating e-learning in education. Figure 63 summarizes the main perceived advantages of e-learning.

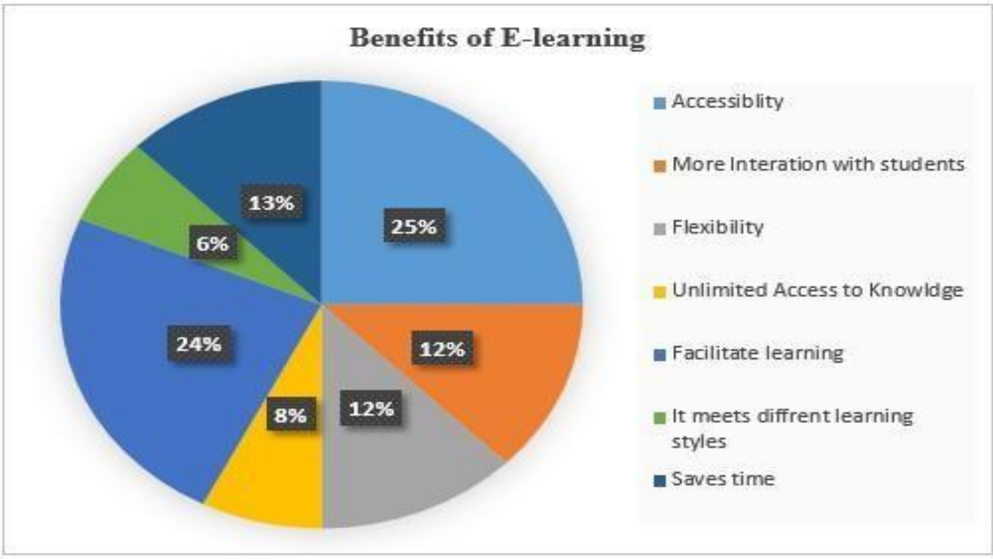


Figure 63. *Benefits of E-Learning According to Teachers*

The respondents cited too many advantages of e-learning, for instance, 25% (N=20) of the them find that accessibility is a prime benefit of e-learning since they can have access to updated content whenever they want, 24% believe that e-learning facilitates teaching and learning because it makes a considerable volume of resources available. While 13% claim that e-learning saves time because of the possibility of quick delivery of lessons, 12% consider e-learning as a good environment for group and collaborative interaction with the students, whereas some respondents referred to other advantages such as unlimited access to knowledge and increased flexibility in their teaching.

The respondents were also asked to choose according to them the positive impacts of e-learning on students. Table 124 presents their responses:

Table 124. *Respondents' Perceived Impacts of E-learning On Students*

		Responses		Percent of Cases
		N	Percent	
What impacts have e-learning on students[a]	*Help them be more independent	57	43,5%	79,2%
	*Help them be more active in the classroom as well as outside the classroom	41	31,3%	56,9%

	*Help them develop communicative and creative skills	33	25,2%	45,8%
Total		131	100,0%	181,9%

a. Dichotomy group tabulated at value 1.

Regarding the perceived impact of the use of e-learning on students , 43.5% (N=57) of the respondents believe that the use of technology allows students to be more independent, 31.3% find that it allows them to be more active inside and outside of the classroom, while 25.2% think that it helps them develop communicative and creative skills.

4.1.5.3. Teachers' Perceived Disadvantages of E-learning

As already mentioned in the literature review, although e-learning can improve the quality of teaching and learning and simplify its process, some researchers believe that its inappropriate use disrupts the teaching and assessment process. Therefore, this section attempts to answer the seventh research question that investigates the disadvantages of using e-learning in higher education as perceived by the teachers.

- RQ7: What are the perceived disadvantages of integrating e-learning in higher engineering education?

To gain the teachers' view on the drawbacks of e-learning, survey respondents were asked to state the main disadvantages of integrating digital learning in education. The following bar graph (figure 64) summarizes their answers.

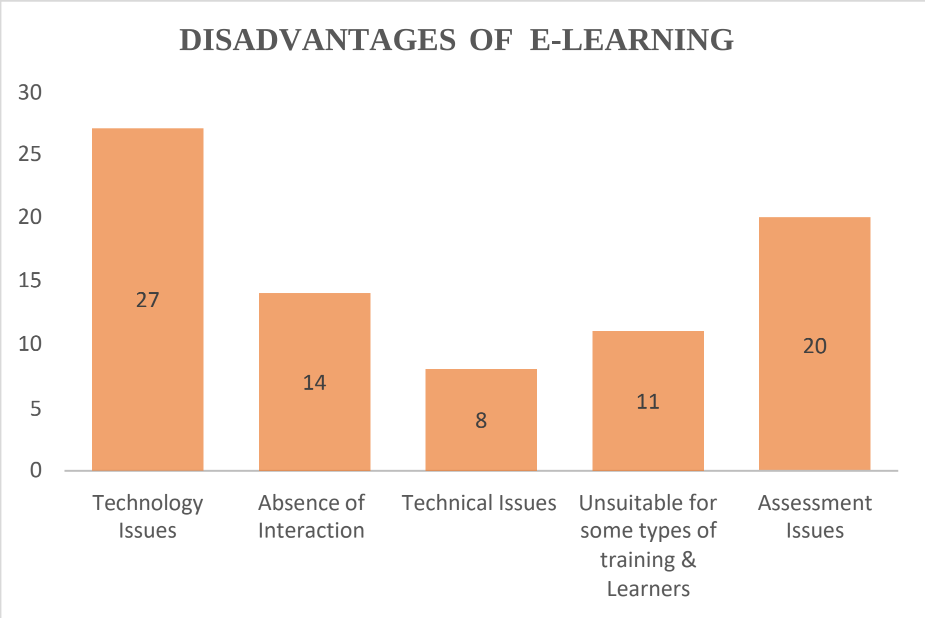


Figure 64. *Drawbacks of E-Learning According to Teachers*

As mentioned in figure 64, the majority of the respondents (33.75%) pointed out that technology issues are the frustrations and demotivation aspects of e-learning; moreover, 20 out of the surveyed respondents stated that assessment becomes complicated especially when dealing with a great number of students, they represent 25%. Likewise, 17.5% (N=14) referred to the lack of sufficient learner-teacher interaction, which according to them allows better mutual understanding as it can negatively impact the student's learning. On the other hand, 13.75% (N=11) identified e-learning solutions as not suitable for all types of training and do not appeal to all learning styles, whereas the remaining participants (10%, N=8) believe that technical issues are the main disadvantage of e-learning.

4.1.6. The Integration of E-learning in Moroccan Higher Education

4.1.6.1. The Current Practice of E-learning in Higher Engineering Institutions

This section attempts to identify the extent to which e-learning is manifested in higher education institutions (HEIs) to enhance teaching and learning processes. Therefore, it tries to answer the eighth research question that examines the current practice of e-learning in Moroccan higher engineering institutes.

- RQ 8: To what extent e-learning is manifested in Moroccan higher engineering education?

To answer this question, the respondents were first asked whether the academic curricula include any modules, units, or subjects that require the use of e-learning particularly (online learning /distance learning)

Table 125. *Frequency and Percentage for the Institution Inclusion of courses that require the Use of E-learning*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	29,5	29,5	29,5
	No	55	70,5	70,5	100,0
Total		78	100,0		

Based on table 125, 23 out of the 78 respondents who answered this question confirmed that the academic program includes courses that need the use of e-learning; they represent 29.5% of the sample. On the other hand, the vast majority of the surveyed respondents (70.5%, N=55) claimed the opposite.

Moreover, the respondents were also asked if the institution they belong to has ever organized an event that aims to raise students' awareness and develop their critical thinking regarding e-learning. Table 126 presents the respondents' responses:

Table 126. *Frequency and Percentage for the Institution Organization of Events to Raise Students' Awareness towards E-learning*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	11	16,18	16,18	16,18
	No	57	83,82	83,82	100,0
Total		68	100,0		

A study of the results shows that 57 out of the 68 respondents who answered this question denied the fact that their institutions have ever organized events that aim to raise students 'awareness towards e-learning; they represent 83.82%, while only 16.18% (N=11) claimed the opposite.

Another question that the surveyed participants were required to answer is whether the Moroccan education system has made any efforts to incorporate e-learning into higher education. Table 127 presents a distribution of the respondents' responses:

Table 127. *The Efforts Made by the Moroccan Education System to Integrate E-learning into Education*

Has the Moroccan System Made any Efforts to Integrate E-learning in Education?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	52	68,42	68,42	68,42
	No	24	31,58	31,58	100,0
Total		76	100,0		

Based on the findings, we notice that the majority of the respondents (68.42%, N=52) confirmed the efforts made by the Moroccan education system to implement e-learning in higher education, while 24 respondents believed that no efforts have been made to; they constitute 31.58% of the sample studied.

4.1.6.2. E-learning Readiness in Public and Private Engineering Higher Institutions

As e-learning is witnessing significant growth in higher education, an assessment of the institutional readiness is of paramount importance for its effective integration in education. Thus, this section attempts to answer the ninth research question that explores the level of e-learning readiness in both public and private institutions for a successful implementation of e-learning strategies.

- RQ 9: Is there any difference regarding e-learning readiness between public and private Moroccan HEIs?

In order to answer this question, the researcher first cross-tabulated the two variables namely "does the academic curricula include any modules, units, or subjects that require the use of e-learning" and "has your institution ever organized any event that aims to raise students' awareness and develop their critical thinking regarding e-learning" with the variable “institution”. In order to make this correlation of variables more relevant, the researcher has on the one hand opted for a regrouping of the first and second variables on the SPSS software; on the other hand, she took into consideration only the "yes" answers of the two questions.

Table128. *Correlation between the Institutional Readiness and Establishment*

The Institutional Readiness * Establishment Cross-tabulation

			Establishment		
			ENSA	EMSI	Total
Institutional readiness	Does the academic curricula at your establishment include any modules, units, or subjects that require the use of e-learning (online learning / distance learning)?	Count	13	10	23
		% in the institutional readiness	56,5%	43,5%	
		% in institution	76,5%	83,3%	
	Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?	Count	7	4	11
		% in the institutional readiness	63,6%	36,4%	
		% in institution	41,2%	33,3%	
Total		Count	17	12	29

a. Dichotomy group tabulated at value 1.

Table 128 shows that 56.5% of the respondents who answered “yes” to the first question belong to the public institution (ENSA) while only 43.5% of them belong to the private sector (EMSI). As for the second question, almost 64% of the respondents who provided a "yes" answer to this question belong to the public school (ENSA) while only 36% of them teach in the private sector (EMSI). Therefore, we notice that there exist a considerable difference between private and public e-learning readiness. This can be clearly seen from the figure 65 below.

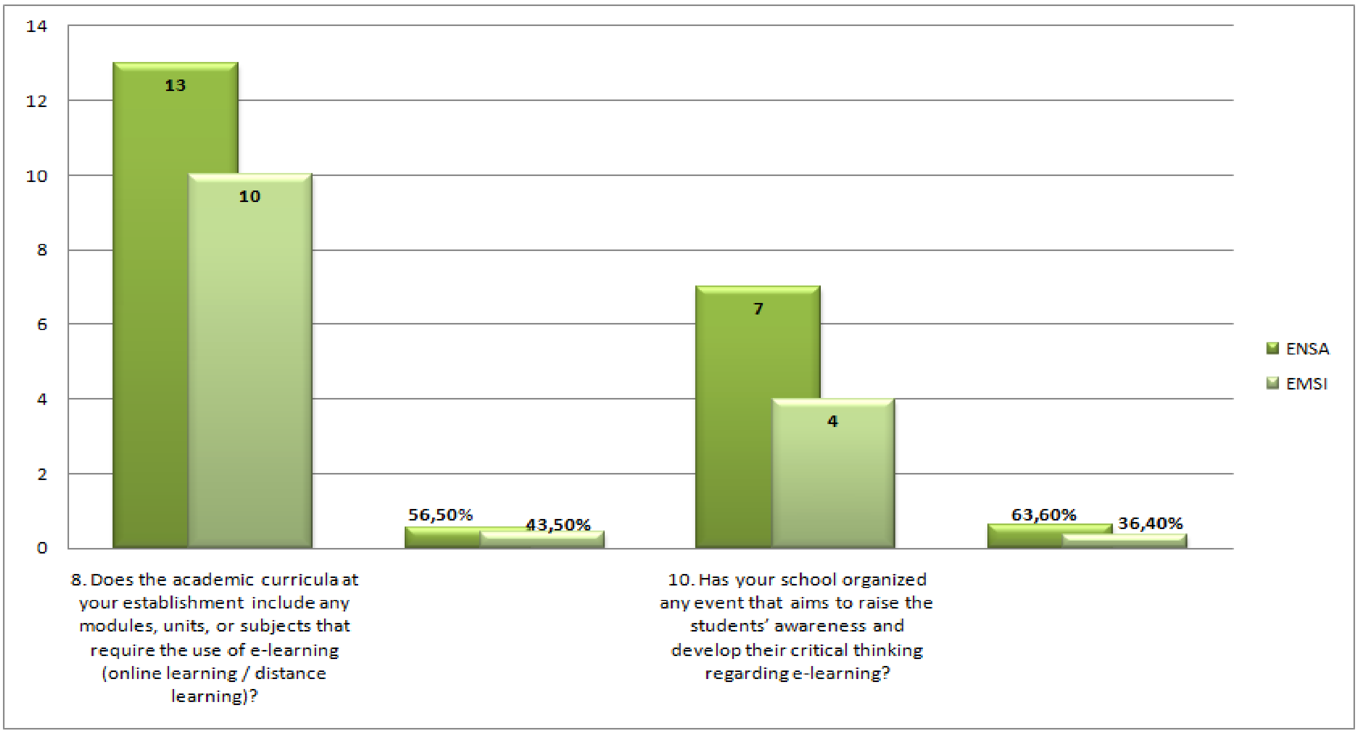


Figure 65. *E-learning Readiness in Public and Private Engineering Higher Institutions*

In order to complete the answer to this research question, the researcher used the Multiple Correspondence Analysis (MCA) to check the contribution of the public/private institution variable in the explanation of the research construct, which is in this case the e-learning readiness. The discrimination measures (table 129 and figure 66 below), consider the public/private sector of the institution, indeed, as a main dimension in the explanation of the said institutional e-learning readiness with a contribution of 78.7%.

Table 129. *Results of the Measures of Discrimination*

Discrimination Measures

	Dimension		Mean
	1	2	
Establishment	,309	,787	,548
Does the academic curricula at your establishment include any modules, units, or subjects that require the use of e learning (online learning / distance learning)?	,480	,150	,315
Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?	,464	,114	,289
Active Total	1,252	1,051	1,151

Discrimination Measures

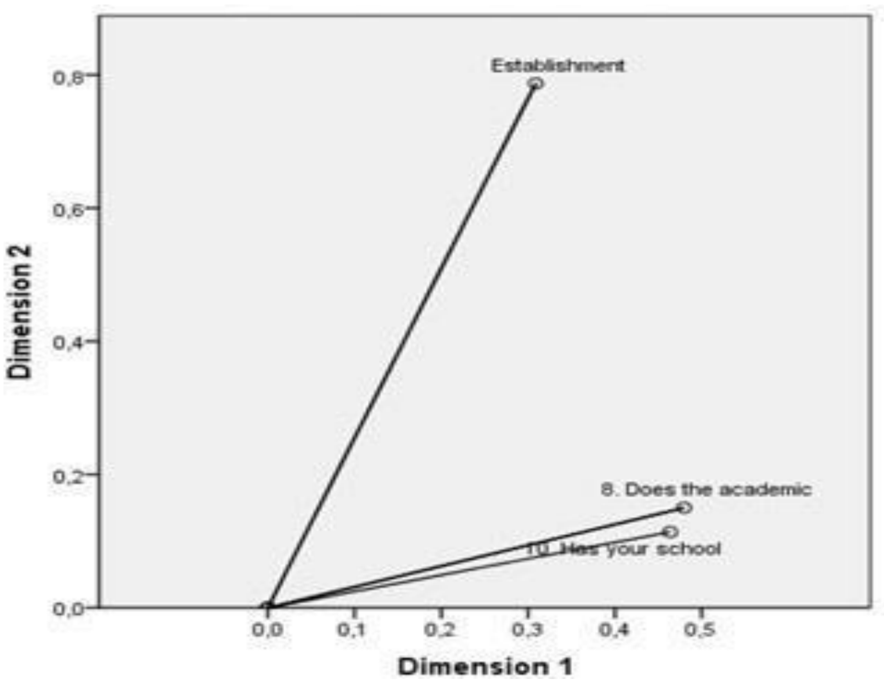


Figure 66. *Plot of Discrimination Measures*

4.1.7. Barriers and Facilitators to the Adoption of E-learning in Higher Education

The purpose of this section is to identify the factors that enable or impede the implementation of e-learning in higher education (HE). Thus, the last research question of the present study examines the various factors that promote or hinder the adoption of e-learning systems in Moroccan higher engineering education.

- RQ 10: What are the factors affecting the adoption of e-learning technology in learning engineering higher education?

4.1.7.1. Critical Success Factors for E-learning Integration

The last research question aims to highlight the perceived facilitating factors that support the integration of e-learning in HE. For this reason, the researcher selected four explanatory variables of this research construct (facilitating factors), namely the efforts of the Moroccan educational system, the events that aim to raise students' awareness organized by the institutions under investigation, the participation of professors in training programs and their role in raising students' awareness towards the importance of e-learning. The correlation table 130 below reveals positive associations between the explanatory variable.

Table 130. *Summary Results of a Multivariate Analysis Relating Different Variables*

	Has the Moroccan education system made efforts to raise	Has your school organized any event to raise the?	Have you participated in a training on e-learning technology?	Have you tried to help students be aware of e-learning?
Has the Moroccan education system made any efforts to integrate e-learning?[a]	1,000	-,052	,074	,101
Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?[a]	-,052	1,000	,020	,218
Have you ever participated in a training, which concerns e-learning technology?	,074	,020	1,000	,106
Have you ever tried to help your students be aware of the importance of e-learning technology and comprehend its role?[a]	,101	,218	,106	1,000
Dimension	1	2	3	4
Proper Value	1,268	1,077	,922	,733

Moreover, the results do not show a significant influence between the variables studied. Nevertheless, the discrimination measures (see table 131 below) reduces the four explanatory variables mentioned above into two main explanatory dimensions.

Table 131. *Results of the Measures of Discrimination*

Discrimination Measures

	Dimension		Mean
	1	2	
Has the Moroccan education system made any efforts to integrate e-learning into higher education?	,019	,654	,337
Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?	,456	,226	,341
Have you ever participated in a training on e-learning technology?	,213	,280	,246
Despite these obstacles, have you ever tried to help your students be aware of the importance of e-learning technology and comprehend its role?	,629	,004	,317
Active Total	1,318	1,163	1,240

According to the discrimination table 131, and figure 67 below, we retain two main dimensions. The first dimension corresponds to the teachers' role in raising students' awareness towards the importance of e-learning technology with 62.9% of explanation. While the second dimension is related to the efforts made by the Moroccan educational system to integrate e-learning in HEIs with a contribution of 65.4%. In other words, the two fundamental factors that according to the teachers facilitate the integration of e-learning in higher engineering education are the government policies for e-learning, and the support, advice, and recommendations that professors provide to their students in order to raise their consciousness towards the importance of e-learning technology.

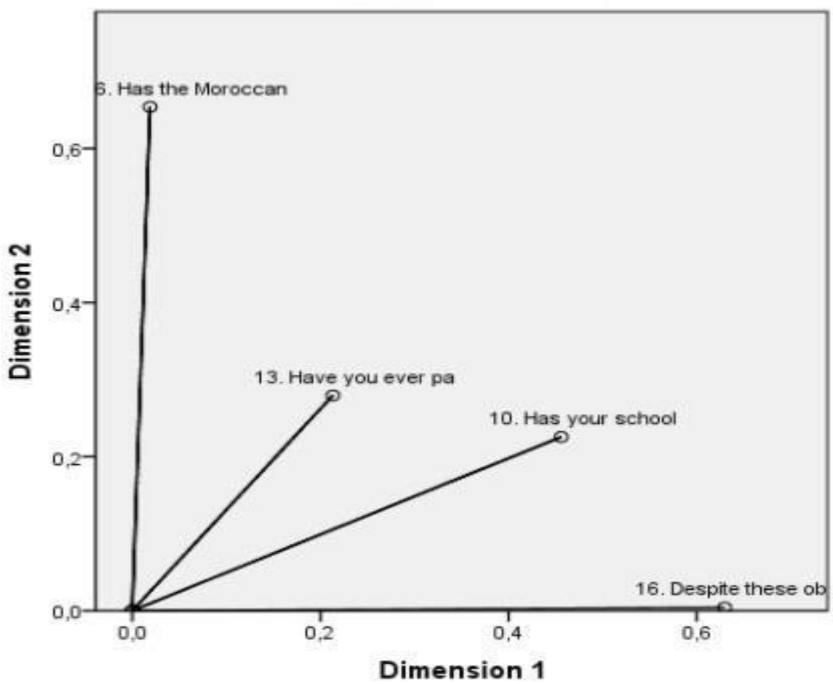


Figure 67. *Dimensional Plot of the Discrimination Measures*

4.1.7.2. Challenges Facing the Adoption of E-Learning

As previously discussed, many developing countries expressed their interest to integrate e-learning solutions in their education systems but faced major challenges that impeded its successful implementation. In fact, e-learning is still in its infancy in developing countries due to many obstacles. This section, however, tends to shed light on the teachers' perceived critical factors that hinder the adoption of e-learning in Moroccan higher engineering education. To answer this question, we selected six explanatory variables of this research construct (barriers to e-learning integration) namely the lack of resources (material, human, and of time), efforts of the Moroccan educational system, the events that aim to raise students' awareness organized by the institutions under investigation, and the participation of professors in training programs.

Table 132. *Summary Results of a Multivariate Analysis Relating Different Variables*

	Has your school organized any event…?	Have you participate d in a training …?	Role of the Moroccan university vis-à-vis e-learning…	Lack of qualitative tools and materials	Lack of training for teachers	Lack of time
Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?[a]	1,000	,024	,193	,159	-,118	-,047
Have you ever participated in a training which concerns e-learning technology?[a]	,024	1,000	,582	,123	-,055	,222
What role does the Moroccan university play vis-à-vis the integration of e-learning?	,193	,582	1,000	,526	,015	,379
Lack of qualitative tools and materials[a]	,159	,123	,526	1,000	,118	,197
Lack of training for teachers[a]	-,118	-,055	,015	,118	1,000	,099
Lack of time[a]	-,047	,222	,379	,197	,099	1,000
Dimension	1	2	3	4	5	6
Proper Value	2,097	1,170	1,028	,750	,700	,256

As table 132 indicates, there exist no significant influence between the variables examined, except for the relationship between the role of the Moroccan university and the training carried out by the professors in terms of e-learning, which reaches 58.2% of explanation. Thus, we can say that a very moderate relationship exists between these two variables. However, the discrimination table below reduces the six explanatory variables mentioned above into two major dimensions.

Table 133. *Results of the Measures of Discrimination*

Discrimination Measures

	Dimension		Mean
	1	2	
Has your school organized any event that aims to raise the students' awareness and develop their critical thinking regarding e-learning?	,040	,026	,033
Have you ever participated in a training on e-learning technology?	,466	,111	,289
What role does the Moroccan university play vis-à-vis the integration of e- learning?	,860	,979	,920
Lack of qualitative tools and materials	,474	,088	,281
Lack of training for teachers	,013	,817	,415
Lack of time	,338	,001	,169
Active Total	2,191	2,022	2,107

From the discrimination table 133 and figure 68 below, we retain two main dimensions. The first dimension corresponds to the unfulfilled role of the Moroccan university vis-à-vis the integration of e-learning into education with 86% of explanation. While the second dimension relates to the absence of training programs dedicated to teachers in order to enhance their digital skills, with a contribution of 81.7%. In other words, the two fundamental factors that according to the teachers impede the integration of e-learning in higher engineering education are the lack of support and training for teachers and the lack of government initiatives to develop e-learning resources.

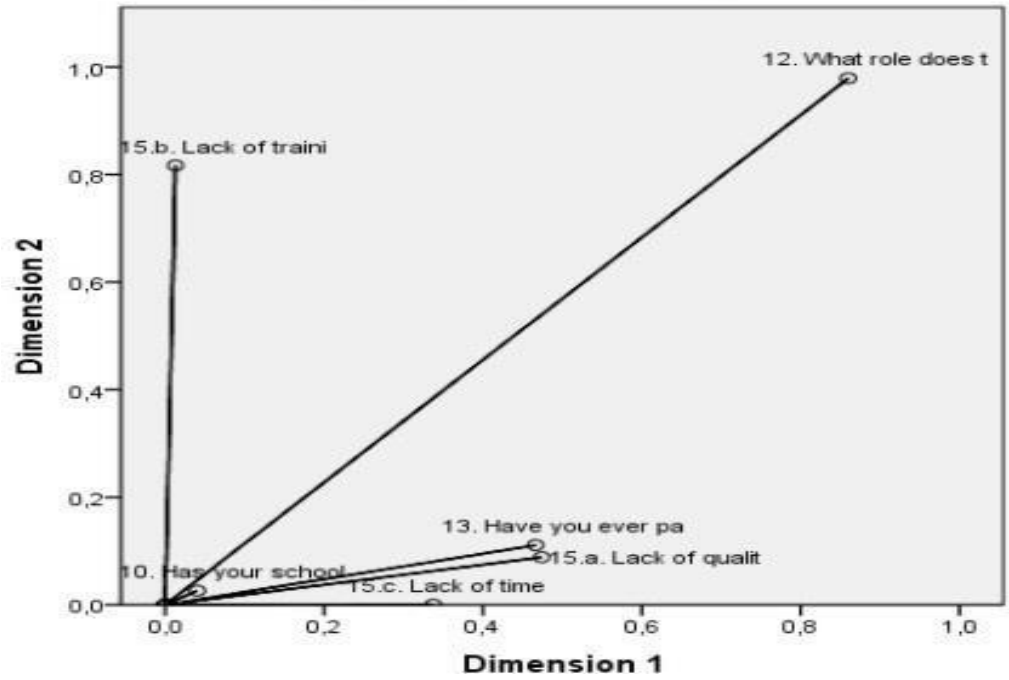


Figure 68. *MCA Dimensions Discrimination Measures*

Section Two: Presentation of Findings and Data Analysis of the Semi-Structured Interview

4.2. Findings of the Semi-Structured Interview

In this study, the researcher adopted a qualitative (QUAL) research method using semi-structured interviews in order to gain a comprehensive idea about the participants' perceptions towards e-learning integration in higher engineering education. The principle mission of the researcher during QUAL research is "to capture, understand, and represent participants' perceptions and meanings through and in their own words" (Ruona, 2005, p. 243). Thus, to interpret the participants' meanings, data are generally analyzed adopting either some sort of discourse analysis, which emphasizes the use of language to construct and interpret meaning or interpretive thematic analysis in which data are coded to determine the main themes and repeated patterns of meaning (Polio & Friedman, 2016). In this doctoral dissertation, the data collected were mainly analyzed using content thematic analysis due to its flexibility and capacity to offer a detailed account of data.

The adoption of semi-structured interviews as a data collection method allows the participants to speak in their own words on the topic of interest as it allows the interviewer to adapt and direct the interview to clarify ambiguous issues. In the interview process, the researcher tried to establish rapport with the interviewees and maintain an easy conversational tone. The participants were encouraged to talk about their own experiences with ICT and particularly the use of e-learning in their teaching. The primary objective behind the data collected from these interviews is to support the research questions by offering profound and additional details about the interviewees' experiences that could not be obtained through survey questionnaires. The data targeted concrete experiences based on e-learning adoption in teaching engineering and focused on the participants' attitudes towards the application of e-learning and on perceptions, opinions, and preferences regarding learning technology. Correspondingly, interviewees were required to answer the following set of questions:

5. Would you mind if we talk about your experience of employing modern computer technology in teaching engineering?
6. What kind of benefits can professors receive from employing e-learning in teaching engineering?
7. What are the challenges and obstacles that hinder the successful integration of e-learning in higher education?
8. Do you suggest additional recommendations or propositions about the practicality of electronic learning in the department of engineering?

It is worth mentioning that the researcher conducted the interview with 16 university teachers from public and private higher institutes of engineering in the city of Marrakech in Morocco. T1, T2, T3…T16 represent the teachers or the interviewees, whereas Pub (Public) and Pvt (Private) represent the type of the institution. The answers obtained from the semi-structured interview were analyzed qualitatively utilizing thematic content analysis to identify the major themes disclosed in the participants' responses.

4.2.1. Teachers' Experience with ICT

The first question aims at exploring the participants' experience of Information and Communication Technologies (ICTs) in teaching engineering. Indeed, talking about their experiences is of paramount importance since teachers are the driving force in creating change in education by the effective and efficient integration of ICT into classroom settings. During the coding and the data analysis process, the researcher recognized that faculty experience with

ICT is characterized by factors that emerged as themes. These themes were synthesized and three significant themes were developed as follows:

- Lack of ICT skills
- Lack of training
- Attitudes towards ICT

4.2.1.1. Lack of ICT Skills' Manifestations

Participants' responses in terms of their experience with ICT demonstrated a lack in terms of their digital skills, which is a critical component in effective implementation of e-learning in education. Although the majority of the interviewees (87.5%) claimed to be able to use a computer and serf on the Internet, still they do not know how to integrate technology to transfer the pedagogical content. A male university teacher referred to his low level of ICT skills as follows:

> *While I was trained to be a teacher back in the 1990s, I was never taught how to use ICT in teaching. I do not possess the right skills to incorporate ICT tools in my lesson. Lack of digital competence is my problem*. (PubT#2)

The respondent clearly stopped at the main reason behind his disability to incorporate ICT in his teaching process. For him, the teaching trainings and practicums were an opportunity to learn pedagogies and strategies not ICT. In the same vein, a female respondent added:

> *My ICT skills are very basic to the extent that I lack self-confidence to adopt it in my pedagogical practices. However, I do really believe that it is a potential tool to improve the quality of education*. (PubT#6)

Due to the lack of technological competence, university teachers find it hard to use ICTs in the classroom and therefore contribute to the effective implementation of e-learning in education. However, although they lack the adequate skills to use ICT tools in their lessons, some teachers showed their willingness to adopt e-learning if they receive trainings that enhance their digital skills and performances. In this regard, one of the interviewees explained:

> *I do not mind using ICT in the classroom. In fact, ICT enhances interaction and increases students' engagement and motivation to*

learn. However, I do not possess the necessary skills to incorporate it in my classes. I would like to be trained so that I can be 100% confident and then use it as a teaching tool. (PvtT#11)

This is an indication that the teachers' skills relate directly to their self-confidence, which implies that teachers' lack of technological skills becomes a critical barrier preventing them from using ICT in educational settings.

4.2.1.2. Lack of ICT Training: A Real Hindrance

Some interviewees (35%) referred to their negative experience with ICT due to the lack of training and workshops on ICT use in teaching. They explained that they have not been trained to use developed technology in the classroom, and that they need to be equipped with the digitally based teaching competences and experience. Three teacher participants responded as follows:

> *I do not have enough skills to use ICT, and I need training on how to use the tools or something like that.* (PvtT#13)
>
> *Yes, I know how to use a computer but so far, I have not yet been trained to use it for educational purposes*. (PubT#7)
>
> *I need to be trained first and then use ICT tools to impart knowledge. To be honest, I do not feel confident using technology especially when dealing with the net-generation.* (PubT#4)

Obviously, the reason for not integrating ICT in their pedagogic practices was due to the absence of practical training sessions and workshops, which accordingly, results in lack of knowledge on the application of digital resources and lack of self-confidence

4.2.1.3 Attitudes towards ICT: Perceptions and Insights

Integrating e-learning in education depends crucially on the teachers' attitudes and perceptions towards ICTs. In this interview, the participants' responses were classified into two categories: teachers with positive and satisfactory attitudes towards ICT and others with negative beliefs.

It is worth noting that the teachers' attitudes are among the factors that influence the adoption of ICT in teaching. Some interviewees (81.25%) showed strong positive attitudes towards ICT and its role in facilitating both teaching and learning processes. One of the interviewees explained:

> *Though some of my colleagues find that using ICT in the classroom is time-consuming, I find myself very comfortable when I embed technology in my teaching practices. I do no more take the role of the knowledge producer, but a facilitator and mentor since the learners take control of the lesson*. (PubT#8)

The interviewee, in this regard, obviously demonstrated the effectiveness of ICT incorporation in changing the teacher's role from a producer of knowledge to a facilitator and advisor. These alternative roles make of the learning process more student-centered; the students are more encouraged to participate in the knowledge construction and they show less consumerism. This implies that using ICT tools as a strategy to execute learning contents and components in teaching makes it dynamic for both lecturers and learners.

A further comment was elicited from another male interviewee:

> *Actually, as an academically qualified person, the university teacher is expected to embed ICT in teaching since we are living in a world that is determined by technology. For me, ICT makes the learning process easier and more attractive*. (PvtT#10)

Like the previous interviewee, the respondent plainly encourages the use of ICT at the academia. He believes that technology has become unavoidable among 21st century e-generation and it has become a prerequisite in both teaching and learning processes thanks to the advantages it has.

Responding to the interview question, another male interviewee claimed:

> *From my point of view, ICT helps teachers teach more confidently. Personally, I can present materials better to my students.* (PubT#3)

ICT has a number of benefits. According to the interviewee, it helps the teacher audio visually present materials to the students. It also enables the teacher to gain more self-confidence, self-esteem, and control over the material.

In the same context, another interviewee added:

> *Well, I use ICT from time to time when I face problems explaining a new difficult scientific concept. I actually search for explanatory videos, I choose one that is suitable and I use it to demonstrate the concept to my students. I believe it is much easier to use ICT in teaching physics*. (PvtT#12)

That is to say, positive attitudes towards e-learning technology directly promote its integration and application in the teaching practice and vice-versa. In other words, if lecturers constantly employ ICT facilities to upload their lecture notes, PowerPoint presentations and assignments, it will positively influence their attitudes towards e-learning technology. That is, positive attitudes of lecturers towards technology significantly affect their use and implementation of ICT tools into their pedagogical practices. Nonetheless, other teachers prefer to use old traditional approaches due to their lack of motivation, willingness and readiness towards educational technology.

Based on the interview data, some interviewees (18.75%) showed negative attitudes towards the use of ICT in education, which negatively influenced its integration in their classes. Some of them expressed lack of interest while others are just resilient to change and not ready to use technology as an educational tool. Lack of interest is echoed across the following cases:

> *Being a teacher, teaching with ICTs is not an easy task, I am not only required to keep myself updated with the rapidly evolving technologies, but I need to choose and use the appropriate strategies to make sure students are on task when using technology in class*. (PubT#7)

Consistent with the above comment, a teacher of mathematics explained:

> *As a teacher of mathematics, I do not think it is necessary. The nature of the subject I teach contains problems, which need clarifications through step-by-step solutions. Therefore, the interaction between the teacher and the student is highly recommended. Despite using the*

traditional "chalk-and-talk" method, I sometimes find it challenging to explain the techniques used in solving these problems… (Pause) I wonder how it would be if I use ICT tools… (PvtT#16)

A further comment by a teacher who seemed resistant to change:

I do not trust digital technology; what if the device I use breaks down? Do not you think that this may affect the lesson time and flow? Technology is great, but it is more of a double-edged sword. (PvtT#9)

From the responses provided, it seems that the interviewees holding negative attitudes towards educational technology do not believe that ICT has any advantages neither for them nor for their students. These teachers keep employing traditional methods despite being informed of the importance of ICT in the teaching and learning processes. It is unquestionable that teachers' attitudes are one of the major determinants that promote or deter the integration of ICT in education. Therefore, teachers should develop a positive attitude in order to contribute to the innovative use of ICT.

Based on these insights, one can deduce that the majority of participants (81.25%) are aware of the importance of ICT and they even stress its use in education. Besides, many of them can easily use different ICT resources in their teaching practices particularly when it comes to delivering complex and difficult concepts. Whereas some interviewees emphasize the importance of digital literacy and the way it affects the use of ICT in teaching and learning. They also value the importance of teachers training for building and improving self-confidence when using such modern tools. Nevertheless, another group of interviewees (the non-user teachers) believes that using ICT for educational purposes is useless and pointless. They think that implementing ICT needs much effort and time; technical issues and effective operation of educational software are also among the concerns of this category of interviewees.

4.2.2. Spectrum of the Benefits of E-learning

The second question examines the benefits that educators can receive from adopting e-learning in teaching engineering. Therefore, the coding and the data analysis process of the interviewees responses resulted in the emergence of two main themes and sub-themes within each:

4.2.2.1. Advocates of E-learning: Appreciation and Adoption

The participants' responses indicated great appreciation to e-learning technology and its ability to enhance teaching and learning. The categories that were used to develop this theme were flexibility in the teaching process and enhancement of student-teacher interaction.

- **Student-Teacher Interaction: Rapport-Building**

Student-teacher interaction is an essential prerequisite for a successful e-learning environment. The use of e-learning by faculty members is considered an advantage since it provides them with the necessary tools to smoothly impart knowledge to their students. A teacher participant supports this claim, stating that:

> *The most important benefit of embedding e-learning in education is that it adds vitality to instructor-student interactions. The teachers should not be overly reliant on traditional lecture-based teaching methods. We are dealing with a digital generation that has different expectations about education.* (PvtT#13)

The new role of the instructor is determined by students of the millennial era, students who consider information technology (IT) as a component of their culture and appreciate being taught employing technology-based learning. Consequently, teachers are required to adopt new digital instructional methods to meet their students' needs. One of the interviewees revealed:

> *Well! When I use multimedia learning tools, I notice that my students become more enthusiastic, the thing that allows them to control and manipulate the course content and thus become fully engaged in knowledge construction. Therefore, the teacher becomes a facilitator and a monitor rather than a source of knowledge.* (PubT#2)

The same motivation for using e-learning tools as innovative pedagogical methods to meet the needs of the 21st century learners is expressed as follows:

> *Honestly, e-learning requires substantial planning, preparing and implementing to ensure effective learning. To do so, teachers are required to adjust their instructional practices on a regular basis in order to meet the learners' need. For me, though it is time consuming,*

> *I find it interesting to know new things and discover new teaching approaches and share them with my students.* (PvtT#15)

The emphasis on the power of e-learning to involve students more in the learning process was echoed by another interviewee who stated:

> *In fact, I heartily believe that "a picture is worth a thousand words". As a teacher, I rely a lot on visual aids simply because they arouse the interest of students as they help the teacher explain the concepts easily and clearly.* (PubT#1)

Based on the responses above, digital content enables the teachers to achieve the educational objectives; it also enhances the students' learning outcomes since it has the power to facilitate dynamic learning that is more entertaining than traditional old methods.

- **Flexibility of Course Delivery: New Prospects**

Another benefit of e-learning that according to the interviewees makes both the teaching and learning processes more effective is its flexibility of course delivery. E-learning provides teachers and learners with easy access to educational resources regardless of time and space constraints. This is evidenced by two teacher participants who claimed:

> *E-learning has the power to make learning occur anytime at any place. Its adoption grants flexibility of time and place for content delivery".* (PubT#8)
> *"Actually, the adoption of e-learning enhances the efficacy of knowledge via ease of access to a broad amount of up-to-date resources and relevant materials*. (PubT#4)

E-learning tools, according to this category of teachers, is an effective instrument for extending educational opportunities due to its power to transcend typical time and space barriers.

4.2.2.2 Opponents of E-learning: Rejection and Refutation

Based on the data collected, only two interviewees did not see any benefit of e-learning in teaching engineering. This negative attitude is mainly due to the fact that some faculty members rely a lot on old instructional methods or simply due to the lack of interest to use e-learning tools in their teaching. Two teacher participants expressed their unwillingness to educational technology as follows:

> *Honestly, I cannot state the benefits of e-learning simply because I do not rely on it for my teaching practices. I prefer conventional face-to-face instruction*. (PvtT#16)

> *Advantages! Hmmm. I do not see any advantage in using e-learning for teaching purposes*. (PubT#7)

Based on the responses to the second question, it should be noted that the majority of participants favorably perceive e-learning as it offers various opportunities for interactive learning. According to them, e-learning enhances students' engagement, participation, interaction and involvement in the educational process, a learning environment that promotes self-regulated, and self-directed learning. Others however, appreciate e-learning tools since they view them as pedagogical resources that facilitate teaching and help teachers easily convey meaning.

On the other hand, some interviewees (a minority=12.5%) see no advantages of e-learning simply because they have never experienced it or because of their negative attitudes towards it. After analyzing the participants' answers, they were coded and classified into two main categories: advocates of e-learning who view e-learning as a valuable teaching strategy (the predominant category= 87.5%) and opponents of e-learning who stick to the traditional face-to-face education, representing a minority (N=2).

4.2.3. E-learning Implementation' Stumbling Blocks

The third question in the interview aims at exploring the factors and obstacles that hinder the integration of e-learning in higher education. In this regard, interviewees were asked to list the main obstacles that hamper the effective use of e-learning in higher education settings. Based on their responses and after the coding and the data analysis process, the researcher identified two main themes and sub-themes within each.

4.2.3.1. External factors: Infrastructure, Training, and Technical Support

The first theme and which many interviewees (87.5%) referred to as a potential barrier to the implementation of e-learning in higher education pertains to external factors. The categories that were employed to develop this theme based on the interviewees' responses were lack of ICT infrastructure and facilities, lack of teacher training, and lack of technical support.

- **Lack of ICT Infrastructure**

Almost all teacher participants (93.75%) pointed a finger at the lack of appropriate ICT resources as a major obstacle for not using e-learning in their teaching practices. In fact, access to ICT infrastructure is a prerequisite for the integration of e-learning in education. Successful e-learning depends largely on the availability of ICT facilities. Interviewees referred to the lack of infrastructure as a major issue that should be given considerable attention. This is illustrated by the following statement:

> *One of the barriers that prevent teachers from adopting e-learning in instruction is lack of appropriate facilities. As a teacher in the public sector, I would say that our institution has inappropriate and insufficient ICT infrastructure. For instance, if I want to use some e-learning activities in the classroom, I need to book a projector at least two days in advance due to the limited resources. Imagine*…! (PubT#5)

The next comment confirms the teachers' dire need for ICT infrastructure and equipment:

> *Successful implementation of e-learning into teaching relies mainly on the availability and accessibility of ICT infrastructure. I would appreciate it if all teachers at our institution at least own a personal laptop that is connected to the Internet. Unfortunately, we still lag far behind in the so-called "digital revolution.* (PvtT#13)

A teacher from the public sector added:

> *We do not have access to the Internet in our institution; the chalk and the blackboard are the only material available. Guess what! I just bring the chalk with me since it is not always available in the classroom …laughter.* (PubT#8)

From these comments, it can be noted that the lack of adequate technology resources and facilities are the main factors discouraging teachers from adopting e-learning in instruction.

- **Lack of Training**

Interviewees also complained about the lack or absence of training programs that help them develop their digital skills in order to meet the needs of today's technology driven age. Actually, both lack of formal training and support of digital skills lead to poor of e-learning adoption by faculty members. A female teacher of mathematics explained:

> *I believe there are various factors impeding the integration of e-learning in higher education system. For instance, the teachers are not trained to use such new technologies in teaching. Thus, there should be some training programs including seminars and workshops on the use of ICT in education. I would be very grateful if they show me how to use ICT to teach mathematics! (PubT#16)*

Based on this comment, the interviewee acknowledged her inability to embed e-learning tools in her teaching practices because she has not been trained to use technology for instructive purposes. She also expressed her willingness to integrate such tools in teaching mathematics if she is well equipped with the necessary skills and competences. That is to say, teachers are willing to improve; however, they still do not have support, training, and access to adequate ICT resources and facilities.

- **Lack of Technical Support**

The participants' responses indicated that lack of technical support is one of the obstacles that prevent them from adopting e-learning in teaching. The interviewees claimed that lack of assistance is one of the top barriers that influence their attitudes towards the use of technology in class. One of the teacher participants recounted his frustration:

> *Without adequate technical support, teachers are not expected to surmount the obstacles that impede them from using ICT. I admit that once I used the projector to deliver a lecture and guess what! 10 minutes later it was no longer working! I tried to fix it but in vain sinceI could not detect the source of the problem.* (PvtT#10)

Lack of technical skills might potentially impede e-learning integration. Not being able to deal with technical issues, teachers will be discouraged from using e-learning tools due to fear of equipment failure. Consequently, they become disappointed resulting in their unwillingness to adopt e-learning in their pedagogical practices.

4.2.3.2. Internal Factors: Skills, Attitudes, and Commitment

The second theme which many teacher participants (75%) referred to as a potential barrier to the application of e-learning in higher education settings relates to internal factors. The categories that were used to develop this theme based on the interviewees' responses were teachers' lack of digital skills, instructors' negative attitudes towards technology, and students' commitment.

- **Lack of Digital Skills**

The majority of interviewees (93.75%) revealed that lacking the necessary digital skills is the reason for not integrating technology in the classroom. They pointed out that the fact of not having the appropriate digital skills is the reason why teachers do not opt for educational technology. One teacher participant expressed his frustration by stating that:

> *Lack of digital skills is a serious obstacle to the implementation of e-learning. Not all teachers are able to use e-learning tools; I have never thought that one day I would embed technology in my classes.* (PvtT#11)

Emphasizing lack of technological competence as a critical factor that hamper e-learning integration in education, another interviewee stated:

> *For me, I believe that lack of digital competence is the major barrier. Not all teachers possess technology-related knowledge. Teachers need specific training programs to develop their skills before they engage in the design of technology-based lessons.* (PubT#1)

Taking into account this comment, we understand that teacher training and digital literacy development cannot be separated since they greatly depend on each other. Therefore, the lack or absence of one of them leads to poor e-learning integration in education.

- **Teachers' Attitudes**

Teachers' attitudes might shape whether and how faculty teachers eventually embed e-learning in their teaching practices. Actually, attitude is an important predictor for teachers' intention to integrate e-learning in education. One of the interviewees referred to the teachers' negative attitudes as one of the obstacles that hinder the use of e-learning:

> *I want to add that teachers' attitude is a main enabling/disabling factor in effective and successful integration of e-learning into the classroom instruction. Some teachers (I personally know) resist change and have no plan on using technology in education although they might be capable of using it; they just stick to the old traditional values.* (PvtT#11)

The narrative in the above quotation evidently emphasizes that teachers' negative attitudes towards technology and resistance to innovation and change become a potential barrier to technology-based learning environments.

- **Students' Commitment**

Some teacher participants (12.5%) termed students' commitment and engagement to be a very important factor for the success of e-learning programs. According to them, an effective e-learning integration depends largely on students' motivation and acceptance of electronic learning. This is highlighted through the following statement:

> *As far as I am concerned, I believe that students' commitment is a basic prerequisite for effective e-learning. Like teachers, students are undoubtedly seen as key components for successful learning. Being motivated and willing to use education technology results in successful e-learning application.* (PvtT#15)

The above comment exemplified views that student's engagement is a key factor for the success of technology-enhanced instruction. Students' high motivation, willingness, and acceptance contribute to an operative and successful e-learning environment.

The participants' responses to this question were coded into response categories; they were primarily classified into various response patterns: the first category underlines the importance of adequate ICT infrastructure to the success of e-learning programs. This category, which represents the majority, believes that unavailability, and inaccessibility of appropriate ICT facilities is a complex barrier that discourages teachers from embedding new technologies in their pedagogical practices. The second category stresses the importance of professional training programs to promote teachers' knowledge and digital skills to be able to apply them in teaching engineering education. Another category highlights the significance of teachers' attitudes as having a strong impact on technology integration in teaching. Moreover, other participants pointed out further critical factors impeding the integration of e-learning such as students' commitment and engagement. Accordingly, participants hope and expect to find solutions to the external and internal barriers that prevent or delay the implementation of e-leaning in higher engineering education.

4.2.4. Guidelines for Successful Integration of E-learning Initiatives

The last question of the interview aims at examining the participants' recommendations and suggestions for an effective integration and implementation of e-learning in higher education. Therefore, participants were required to identify the factors that need to be considered in the implementation of e-learning. During the coding and the data analysis process, the researcher recognized that faculty recommendations and suggestions are characterized by factors that emerged as themes: technological readiness factors, pedagogical readiness factors and human readiness factors.

4.2.4.1. Technological Readiness Factors

According to some participants (81.25%), an effective and successful e-learning environment depends heavily on technological support. For them, technological factor is one of the critical aspects of e-learning readiness. Thus, without the appropriate technologyequipment the main objective and purpose of e-learning cannot be achieved. They stated:

> *E-learning can open new horizons for both teachers and learners. A solid technology infrastructure can absolutely lay the ground for such a dramatic shift.* (PvtT#14)

> *E-learning may serve as a solid starting point for maintaining high quality education. Yet, the government should empower teachers and*

> *students by granting accurate training programs and ICT infrastructure.* (PubT#3)

> *For me, funding is the biggest challenge here. To provide students and teachers with adequate material (computers/Internet) to access e-learning activities is a necessity.* (PubT#6)

In the light of these comments, we can say that the benefits of e-learning are fully attained only when both instructors and learners have easier access to technology facilities and equipment. That is to say, the lack of technology infrastructure results in the failure of e-learning application.

4.2.4.2. Human Readiness Factors

Another factor that according to the participants plays a vital role in the success of e-learning environments is the human aspect. They referred to teachers' attitudes and students' motivation and acceptance of e-learning as an integral component of successful e-learning systems. Two teacher participants addressed the human factor as follows:

> *I believe that change starts from within; teachers and students should develop positive attitudes towards e-learning and technology as a whole. We must change ourselves first!* (PubT#2)

> *E-learning is no longer a choice; it is part of reality now. We should create environments for our students to learn by themselves; environments that will improve the self-worth of each and every learner.* (PvtT#11)

Based on these comments, it can be concluded that the individual willingness and acceptance of e-learning are crucial for its effective and successful practice.

4.2.4.3. Pedagogical Readiness Factor

According to some teacher participants, successful integration of e-learning is not just about uploading existing teaching materials. Nonetheless, it is a process that requires a set of skills and arrangements that are different from those used in traditional instructions. One of the interviewees stressed that:

> *One should bear in mind that teaching online is not the same as teaching face-to-face; the teaching methods used in traditional classroom settings should be reconsidered and adjusted to meet the requirements of online instruction.* (PubT#1)

In this respect, the teacher's instructional strategies may vary according to the educational context. Thus, creating successful e-learning environments requires a better understanding and preparedness from the teachers in order to create flexible learning environments for students of the 21st century.

4.2.5. Summary

In general, the survey findings showed that the integration of e-learning in the Moroccan higher education system is a process where organizational, systematic, professional, and attitudinal factors are involved. Throughout the survey, participants claimed that adopting e-learning enhances the quality of the teaching and learning processes as it promotes students centered and autonomous learning. They emphasized that e-learning strategies are one of the critical aspects that education system should recognize in order to empower and equip students with the necessary skills to live and work in the information age, and thus help them become lifelong learners and active participants in society.

Nonetheless, the numerical findings demonstrated that the Moroccan educational system in general and higher education in particular, does not offer the necessary tools that allow students and teachers to effectively use e-learning in teaching and learning. In fact, e-learning integration is faced with poor curriculum reforms, inappropriate infrastructure and resources, as well as weak professional trainings for faculty members. Accordingly, teacher-respondents recommended that the Ministry of Education, alongside other stakeholders, should establish national policies and take serious actions and procedures for e-learning to grow and become an integral part of the education system, at the same time invest in offering equipment and advanced training programs for teachers and students to improve their skills and performance.

In general, survey data attempted to raise several issues relevant to the integration of e-learning in Morocco. It tried to offer a thorough understanding of the implementation of digital learning from institution, curriculum, educator, and learner variables. The following is an overview of the major findings from the teachers' survey questionnaire:

- Both University teachers and students value the role of e-learning technology and its effectiveness in enhancing the learning outcomes.
- The integration of e-learning in the Moroccan higher engineering education is still in its initial stages. Curriculum constraints, lack of adequate infrastructure and lack of vocational training sessions for teachers are the fundamental factors that hinder the successful implementation of e-learning in education.
- Moroccan university teachers and students have positive attitudes towards educational technology. Teachers, believe on the potential of e-learning technologies in enhancing learners' critical thinking skills and academic performance.

The data collected via semi-structured interviews were analyzed using set of principles of thematic analysis. The answers were first read by the researcher, gathered in a descriptive table, organized according to their frequency and similarity, and eventually classified into categories. The next step was to reread the common themes in each category, and choose which to keep and which to omit. Then, the researcher provided in-depth interpretations of the answers in accordance with the research questions.

Overall, this section offered results related to the teachers' attitudes and experiences in depth regarding the integration of e-learning in education. Teachers complained about the unavailability of technology infrastructure, absence of professional training programs, and lack of technical support and if implemented, could increase their proficiency in e-learning usage.

In fact, among the issues raised by the interviewees, inappropriate ICT infrastructure emerged as one of the main themes in the interview. They identified technology infrastructure as a critical barrier in e-learning integration as it negatively affects their attitudes and discourage them from using e-learning in many respects. On the other hand, they highlighted the importance of vocational training sessions as another underlying factor that influences teachers' readiness to use e-learning in teaching. For them, IT training would absolutely promote the knowledge and the needed requisite skills and therefore enhance their readiness to use e-learning in teaching engineering education. Eventually, most of the responses indicated the teachers' desire to integrate e-learning in teaching and learning in order to meet the changing needs of teaching the digital generation.

Chapter Five: Discussion of the Research Findings

The former chapter provided an analysis of the results of both the web-based survey and the semis-structured interview. The present chapter offers a discussion of the main research findings based on the research questions, hypotheses, and the literature review. Besides, it highlights the major results that can be adopted by the engineering departments for a successful and efficient implementation of e-learning.

5.1. Summary of Research Findings

This dissertation explores the implementation of e-learning in Moroccan higher education institutions (HEIs), engineering departments in particular; it also examines the factors that influence its successful adoption and application. The available literature indicated that empirical research on the integration of e-learning in higher engineering education is very rare. Nonetheless, a lot has been said about the potential benefits of integrating this modern approach in HEIs. Thus, the purpose of this research was, first, to explore the extent to which ICT and particularly e-learning is adopted in Moroccan higher engineering education. A survey was adopted to assess college students and teachers' perceptions and attitudes towards e-learning, in addition to a semi-structured interview conducted with lecturers to talk about their experiences with technology usage in teaching engineering.

At the current juncture, e-learning is not yet integrated in the Moroccan curriculum. Nevertheless, as discussed earlier, the Ministry of Higher Education has planned to develop new strategies and many initiatives to promote its use in education. Thus, this piece of work seeks to highlight the teachers and students' attitudes and perceptions as main predictors of the adoption of such new approach in educational contexts. In this regard, Banathy (1991) claims that the measurement of any innovation, especially pedagogical plans, should first take into account the level of knowledge and preparedness of its potential users.

Both the quantitative and qualitative data address a number of issues relevant to e-learning in Morocco. The study attempts to offer a thorough understanding of the adoption of e-learning from institution, faculty, and learners variables. Besides, it is an examination of both the teachers and students' perceptions of electronic learning, its practice and challenges, the extent to which they believe e-learning is promoted as a component of the education system, their experiences with teaching and learning using e-learning tools, and eventually the degree of involvement in the development of a successful e-learning environment.

The findings of the paper-based questionnaire showed that there are many factors that push learners to use e-learning such as its perceived ease of use, usefulness, flexibility of the learning process, and the design of the learning resources. Accordingly, using e-learning does not necessitate high skills from learners to possess; they are only required to have an experience interacting with computers and therefore use the e-learning systems easily. Likewise, today's tech-savvy learners have a tendency to use technology in almost every aspect of their lives including education, which implies that they are formerly prepared to employ e-learning tools for educational purposes. In fact, the findings revealed that college students use technology devices and the Internet very frequently, which is a factor that provides them opportunities to engage in technology-enhanced instruction in order to improve their learning outcomes and performances. Nonetheless, learners are not entirely satisfied with the conventional instructional methods; they are passionate about using technology and highly value its role in enhancing learning. Besides, they revealed a strong sense of consciousness about the factors that impede the integration of e-learning in education.

As far as the online questionnaire is concerned, the findings demonstrated that the majority of the university teachers tended to employ a range of ICT resources in their classes to support students' learning and move them toward fulfillment of their individual potential. Actually, the results showed that the level of e-learning technology acceptance among faculty members in terms of awareness and motivation was generally high, except for a minority that is still reluctant to engage in educational technology. Teachers are aware of the fact that learners of the third Millennium need a variety of teaching methods and strategies to enhance the quality of education.

Moreover, like their students, most of the teachers showed a high degree of using computers and the Internet in their daily lives, which is a factor that influences their initial acceptance of technology-enhanced instruction. On the other hand, college professors expressed their frustrations in terms of some barriers that prevent them from embedding e-learning in their teaching practices; for them, e-learning is not yet at the level it should be due to the lack of technology-related training that promotes their digital skills and competencies. Therefore, if not equipped with the necessary skills, teachers are likely to continue employing traditional teaching methods.

For the semi-structured interview, the teachers were required to talk about their experience of using ICT in teaching and learning; the challenges they encounter when embedding these tools and the factors that prevent them from fully integrate it in their pedagogical activities. The findings supported the results of the online questionnaire; most of the teachers showed high level of awareness of the increasing importance of technology in enhancing the teaching and learning processes; they tended to have positive attitudes towards technology and if they use it will help them create more active-learning environments and make a positive difference in education. Nevertheless, they revealed that successful implementation of ICT is primarily influenced by their digital skill level and training. The teachers highlighted the importance of ongoing intensive training programs that develop their digital literacy and technology skills in order to keep abreast of technology trends and thus be able to teach the Net-generation of learners. In addition to the lack of effective training and inadequate digital literacy, the teachers also identified other critical barriers to e-learning integration including lack of access to ICT resources, lack of technical support, and inadequate ICT equipment.

5.2. Discussion of Findings in the Light of the Research Questions and Hypotheses

The present study was guided by a series of primary and secondary research questions that guided the overall direction of this work. Thus, the discussion in this chapter is directed towards supporting the following research hypotheses and answering the research questions:

H1: Moroccan college learners and teachers have inadequate level of ICT skills to adopt e-learning technology.

H2: Several factors influence the adoption of e-learning in the Moroccan education system.

H3: The adoption of e-learning technology can enhance the quality of engineering education.

- RQ1: What type of information and communication technologies (ICTs) do the students and instructors possess and benefit from?

In general, faculty and students are equipped with several technological devices including personal laptops, desktop computers, smart phones, tablets, and other technological tools. Today’s learners are considered digital natives and are immersed in the world of interactive technology such as mobile phones, iPods, and other limitless digital resources. Based on the findings, almost all of the students have access to the Internet at home and use it on a daily basis to access educational resources to keep abreast of information that might not be included in textbooks and therefore take charge of their own education. The same for the teachers, almost all of them own computers and use them frequently. Besides, a majority of them reported to have access to the Internet at home and regularly make use of it to find information resources that could be employed to support their teaching.

- RQ 2: Do they use ICT and particularly e-learning in the classroom for learning and teaching engineering education?

Both university teachers and students are aware of the technological innovation and its role in teaching and learning. Teachers consider modern technology as a teaching tool that will have a significant and positive influence on their teaching. Based on the findings, faculty use a variety of digital tools to deliver content such as projectors, Pcs with connection and recording materials. For them, technology does not only facilitate their job, but has the ability to enhance relationships between teachers and students. In fact, educators look for better ways to transmit knowledge due to the new demands of the digital age. Therefore, via technology-enhanced instruction, learners become active participants in the learning process rather than passive recipients. As far as learners are concerned, the findings disclosed that technology touches every part of their lives; technology does not only provide students with access to countless resources, but it also helps them in the learning process. In fact, students use various online tools for education purposes including virtual worlds, synchronous and asynchronous chat toolsto get more useful information and to connect with different learning groups. Moreover, some of them are even enrolled in some online courses.

- RQ 3: How skilled are the learners and the teachers in using e-learning?

College students in engineering departments of the two higher education institutions are likely to have adequate ICT skills to be employed in e-learning activities. The findings revealed that they were more confident in their digital skills. On the one hand, they use computers and other technology devices almost in every aspect of their life including education. On the other hand, as members of the "Net-Generation", learners are accustomed to high-tech gadgets, use the Internet on a daily basis, and are always up-to-date with new technology innovations, which help them develop appropriate digital skills. These skills would subsequently ensure effective and productive use of ICT resources.

Nonetheless, unlike their students, college faculty possesses basic ICT skills; the findings revealed that they are not tech-savvy simply because they have not had adequate training to prepare them to use technology effectively in teaching. Consequently, Moroccan college teachers call for upgrading teacher training consistently in order to update their skills, knowledge, and experiences in order to keep pace with developments in scientific discoveries and emerging technologies.

- RQ4: How do students and teachers' variables (sex, age, area of study, type of school) pertain to e-learning use and competencies?

The findings obtained from the study established that university teachers are not all qualified to use e-learning systems in their teaching practices. The findings indicated that there is a gender gap among lecturers; whereby male teachers frequently use ICT in teaching as compared to the female teachers. The research results also demonstrated a generation gap amongst university teachers; younger teachers showed considerable interest of learning how to use and adopt ICT in instruction as compared to older instructors, they also showed positive attitudes towards e-learning use to facilitate teaching than their older counterparts. In other words, older teachers are more likely to have developed expertise in traditional learning settings and thus may be less accustomed to new e-learning approaches.

A digital divide has been identified as well; the findings revealed that the private school (EMSI) has access to better technology infrastructure than ENSA School, a public HEI, which makes a large gap in the use of e-learning in education among institutions. The results of the study also demonstrated a direct relationship between the teaching experience of the teachers and their use of e-learning to facilitate teaching, whereby teachers with more teaching experience have shown intentions and interest in adopting such tools to facilitate the teaching process as compared to teachers with less years of teaching experience.

As far as the students are concerned, the findings indicated that junior college students tended to use more e-learning tools than those in their senior years of college. For instance, students who were enrolled in online courses respectively belonged to the first, second, and third year. This implies that junior-level students have a tendency to adopt e-learning more than older senior-level students. This is because younger students sometimes referred to as the "net generation" (Zhao, 2011) or "digital natives" (Horton, 2003), were already born into the digital age. This tech-savvy generation is depicted as encompassing the interactive and immediate nature of online communications; it is therefore more comfortable and experienced with technology than previous generations; as opposed to their older counterparts who are described as “digital immigrants” who prefer slow and controlled information and are usually assumed to have some difficulty with information technology (Inoue, 2007). On the other hand, the obtained findings also showed that male students use more e-learning tools than females. In other words, more male students were found to have positive views and support for e-learning than the female ones.

The research findings expressed that respondents’ familiarity with e-learning has a direct impact on its adoption. For instance, student respondents who were more familiar with e-learning platforms were the ones who enrolled more in online courses. This implies that thereis a relationship between students’ familiarity with technology and the acceptance and adoptionof e-learning. Accordingly, one can deduce that the learners’ decision to use e-learning is dependent on how familiar they are with related technology. That is, learners who are considerably familiar with different forms of technology may have positive attitudes towards e-learning. In the light of this, the researcher believes that when more clarification and information on e-learning technology is provided, it can affect people to accept the concept of e-learning, particularly the females.

- RQ5: How do college teachers and students perceive e-learning technology in learning and teaching higher engineering education?

The findings demonstrated that both university teachers and engineering students have favorable attitudes towards educational technology. As far as the teachers are concerned, they believe that e-learning allows them to provide students with different representations of knowledge. Today’s educators started to realize that e-learning is no longer a choice, but an important infrastructural feature of universities that has a great potential for enhancing learning outcomes and improving quality of education. Nonetheless, a minority of teachers are still resistant to technology use because they have little or even no experience with using technology. On the other hand, since students are familiar with technology and use it extensively in their daily activities, they generally develop positive attitudes towards technology, which influence their readiness to employ it for learning purposes.

- RQ6: What are the perceived educational benefits and opportunities of implementing e-learning technology in teaching and learning higher engineering education?

The research findings have uncovered many benefits of implementing e-learning in higher engineering education. First, e-learning is seen as a modern approach that provides students and teachers with a wide range of updated resources; it has the ability to enhance the efficacy of knowledge via ease of access to a huge amount of information. Second, e-learning motivates students to interact with their peers, as well as exchange different point of views; it has the power to facilitate and encourage communication and interactivity between learners and teachers during content delivery leading to collaborative learning. Third, e-learning eliminates the traditional old model of teaching in which the teacher is the absolute source of knowledge and sole responsible for the transfer of information; e-learning increases students engagement in the classroom by becoming co-creators in the learning process. Eventually, e-learning facilitates and nurtures the learning-teaching process since the instructional content is available for its users at any time; e-learning does not only focus on instruction but it also focuses on learning that is adjusted to individuals.

- RQ7: What are the perceived disadvantages of integrating e-learning in higher engineering education?

In spite of its advantages when adopted in education, e-learning has many disadvantages as well. Based on the findings, one of the common drawbacks of e-learning technology perceived by both university teachers and students is the absence of the teacher. They believe that the most frequent condemnation of e-learning is the complete absence of vital interaction between the teacher and the learners. Lack of communication and interaction with teachers may lead to students' feelings of isolation and remoteness, which in turn influences their motivation level. Moreover, e-learning is perceived as not suitable for all types of training. For instance, engineering education requires practical activities and hands-on experiments; therefore, a face-to-face interaction with a teacher to supervise students and their operation is inevitable. Another disadvantage of e-learning is that it relies on technology a lot; in fact, the use of computers and the Internet form the major component of e-learning; however, not all students own laptops or have access to the Internet at home which disrupts and interrupts the learning process.

- RQ8: To what extent e-learning is manifested in Moroccan higher engineering education?

Both the teachers and students' findings divulged that e-learning is still in its infancy and early stages in Morocco. The investigated institutions still heavily rely on traditional methods of face-to-face instruction. In fact, faculty use computer-enhanced tools to support their teaching; however, there is no official e-learning strategy adopted by Moroccan HEIs.

Digital learning is still not incorporated into the educational curriculum as a basic component. The findings demonstrated that both research sites lack the infrastructure conditions and e-resources that lead to a successful e-learning integration. For instance, the Internet as a vital element of e-learning allows students and professors to stay constantly involved in the e-learning process; yet, it is not accessible to students. When it comes to other e-learning infrastructure such as e-learning platforms, e-learning centers, and the interactive white board, they are poorly evaluated at both research sites, which implies that the adoption of e-learning is slow and still at its infancy stage in Moroccan higher engineering institutions.

- RQ9: Is there any difference regarding e-learning readiness between public and private Moroccan HEIs?

The research findings showed that there are two main differences; technology-related and organization-related aspects. As far as the technology-related aspect is concerned, it seems that EMSI, a private HEI offers "to a certain extent" better technological facilities to its students. This may suggest that private HEIs in Morocco may be IT-driven compared to public HEIs. Nevertheless, although private HEIs may be better situated in the use of e-learning facilities, financial challenges in Morocco hardly allow either the private or the public sectors to hugely exploit the full advantages of e-learning. In fact, satisfaction with technology infrastructure was low among all participating students and instructors from both public and private HEIs. Yet, most of them expressed interest in providing courses that implement e-learning technology.

Regarding the organization-related aspect, the findings demonstrated that ENSA, a public HEI was "to some extent" the one that tried to launch training support initiatives to engage the teachers with e-learning technology to ensure that they master its use and application over time. Besides, the findings also showed that ENSA School was the one that tried to organize more events aiming at raising students' awareness on the importance of e-learning in education compared to EMSI School. Generally, the funding of e-learning initiatives, training and retraining of educators, development of software packages and promotion of adequate ICT facilities are hard to achieve due to insufficient funding.

- RQ 10: What are the factors affecting the adoption of e-learning technology in learning engineering higher education?

Although initial introduction to e-learning initiatives in Moroccan HEIs seems to be progressing, there are still many barriers that might prevent the effective integration of e-learning. The study findings revealed that Moroccan HEIs are facing big challenges to benefit from emerging technological innovations and advents of e-learning to further enhance its teaching programs and to improve the quality of education, especially in engineering fields. Based on the findings obtained from this study, lack of ICT infrastructure and e-resources emerged as the main barriers behind not using and adopting e-learning in engineering education. Although the study showed that both the teachers and students have positive attitudes towards e-learning use in education, availability and accessibility of ICT equipment are very limited. The teachers and learners are willing to improve, but they still do not have support, training, or the accessibility to basic technology.

Another barrier that hinders the effective implementation of e-learning in engineering departments according to the research findings is lack of the teachers' professional training. ICT training opportunities for faculty members are too erratic and sporadic, which implies that many teachers lack the appropriate knowledge and skills to use e-learning technology and are not motivated to adopt it in their teaching practices. In addition to that, the study identified technical support as a serious obstacle to e-learning integration. Technical assistance helps teacher to use ICT in teaching without wasting time through having to fix software and hardware issues; therefore, its lack might discourage teachers from adopting e-learning in the teaching process because of the fear of equipment breakdown during a lecture.

The findings also demonstrated that unwillingness, resistance, lack of motivation, and unawareness as other potential stand as barriers that impede e-learning integration in Moroccan education. Some lecturers just resist educational change and any new experience, which in turn leads to negative attitudes towards e-learning integration. For example, some interviewees reported that the preparation of the e-learning content takes more time than the traditional mode of instruction and that e-learning will reduce their roles and may even substitute them; these negative perceptions in turn will result in lack of appreciation and understanding of e-learning and its benefits. Likewise, students' demotivation is another challenge that prevents the general adoption of e-learning in HE; a high level of frustration emerges when an e-learning activity is poorly organized by faculty members. Ambiguous expectations or changing learning goals frequently during the lecture demotivates learners and generates confusion about the course objectives.

5.3. Discussion of Findings from Literature Review

The literature review started by examining the theoretical framework adopted in the research paper. The theoretical framework that underpins this study is based on constructivist learning theory and connectivism learning theory addressed in chapter two. In this study, the theoretical perspective highlights the role of constructivism and connectivism in a technology embedded learning setting. The theoretical perspective stresses the need for institutions, educators and students to incorporate e-learning technology into teaching and learning so that 21st century skills can be attained and a networked society can be achieved (Duschesne & McMaugh, 2018).

The theoretical framework points that knowledge is compulsory for both individual and community development, and that via technology, information is easily accessible for everyone, at any time and in any place, (Garcia, Brown & Elbeltagi, 2012). This implies that faculty members and students in every higher education institution should be engaged in the knowledge construction as the development of knowledgeable human capital is strongly emphasized in spite of the inadequate ICT conditions encountered in various educational institutions. Accordingly, the theoretical framework requires that both teachers and students must be prepared to become digitally literate and adept at using e-learning technology in order to cope with the rapid changes in knowledge requirements.

The knowledge acquired from the literature review on the theoretical framework offers information that supports the integration of e-learning in HEIs and urges faculty to incorporate e-learning into their teaching practices. This allowed the researcher to answer the main research questions. Based on the study findings, it can be noted that many Moroccan higher education institutions have much more ground to cover before they can fully implement e-learning in education. The lack of adequate ICT infrastructure, lack of digital literacy among teachers, shortage of training courses, lack of technical support and teachers' negative attitudes towards educational technology are among the factors that make the theoretical framework unachievable in developing countries.

The literature review presented in chapter three allowed the researcher to gain a clear view of the research problem. The literature emphasizes the significance of adopting e-learning technology in higher education as considered a key priority and an indispensable part of the education system around the globe. It also offered findings of other studies, demonstrating the effect of e-learning on developing a meaningful student-centered learning environment, which enables students to become actively involved in the learning process and be responsible of their own learning. In other words, permitting learners to find out or construct knowledge by themselves, e-learning technology offers a valuable tool to allow such an active exploration to happen. The literature also indicated that effective teaching in the digital age requires from teachers a high level of digital skills and knowledge, at the same time they need to adapt their teaching methods and adopt new strategies to keep the learners engaged. Therefore, it is imperative for the teachers to be aware and ready for this change (Beisser, Sengstock, 2018).

The overall findings revealed that the level of instructors' awareness of the importance of e-learning is very high. Due to the emergence of a high culture and the increasing exposure of students to technology, respondents who participated in this study believed in the value and effectiveness of e-learning. Over the past few years, faculty members had a skeptical attitude towards educational technologies; nevertheless, now things seem to have changed. University teachers surveyed in this research revealed a favorable attitude towards e-learning and its significance in the teaching-learning process. Likewise, teacher-respondents reported their challenges and motivations towards adopting e-learning into their teaching practices. As Abbot (2003) states in the introduction of his book *ICT: Changing education*, the high rate of technological progress, the explosion in information technology, the fast-paced expansion of the computer, and the increased demand for educating students to meet the future requirements are what evoked the development of educational technology. Teachers involved in this dissertation demonstrated their familiarity with the concept of e-learning technology and showed their understanding of its role in promoting students' outcomes. Based on the statistical findings, the majority of faculty members have positive attitudes to incorporate e-learning into their teaching, aiming at raising their students' awareness towards educational technology.

The relevance of integrating e-learning in the educational setting, as reported by teacher-respondents, consists of enabling the learners to construct knowledge and deep understanding rather than being passive receptors. The teachers indicated that using e-learning in HE settings enables students to actively construct meaning from the sources they encounter and take charge of their own learning. At the same time, it allows them develop a critical reflection to express their opinions and support their beliefs. E-learning technology, according to the surveyed teachers, is a pedagogical strategy set to create new pedagogies and mechanisms, aiming at enabling students to be independent learners by choosing their learning path.

Therefore, such high level of awareness about educational technology can absolutely support the implementation of e-learning in Moroccan HEIs. Nonetheless, research findings revealed that although being recognized as a priority in the teaching-learning process, e-learning is still not promoted as an official component of the educational program in Morocco. According to lecturers, e-learning is applied in theory and not yet in practice. In fact, since achieving independence, promoting quality in education in Morocco has been the main focus; nevertheless, despite the significant efforts made in launching various reforms at the level of curricula and pedagogical approaches, the education system still faces a series of challenges that hinder the achievement of its role successfully. Education should highlight the importance of helping the learners fully develop their inherent potential so that they can autonomously explore the world and manage the learning process. Lecturers reported that teaching in Morocco still adheres to the old values of traditional pedagogical techniques and does not help students enhance their critical thinking skills in order to achieve high standards. Thus, most of the instructors confirmed that e-learning is by no means integrated in the curriculum.

The implementation of e-learning in higher education aims at meeting two primary objectives. The first goal focuses on quality in education, whereby the introduction of ICTs in teaching enhances learners' learning outcomes through innovative and modern approaches. It aims at developing accurate settings for learning, instead of relying solely on the conventional strategies. The second objective focuses on enhancing students' digital skills so as to engage them in the workplace environment that heavily relies on new and modern technologies (Danaher, Gururajan & Hafeez-Baig, 2008).

Nonetheless, as far as the current Moroccan higher education curriculum is concerned, the research findings revealed that e-learning does not appear in the national syllabi neither as an independent unit nor as cross-curricular one. E-learning technology has for so long initiated long and complex debates among scholars about whether it should be integrated as an independent subject or incorporated into teaching other disciplines (Hobbs, 1998). Research in the field assert that the adoption of e-learning across the curriculum develops learners' performance and involves them in multiple learning intelligences (Hui, 2007; Kelly, 2008; Krishnan, 2012; Li, 2013).With respect to the Moroccan higher educational program, only some teacher respondents reported that e-learning is a component of some disciplines. However, they claimed that what the curriculum addresses in terms of e-learning is poor and insufficient.

Apart from the curriculum design, experts in the field of education stated that the successful integration of e-learning technology has faced a series of obstacles due to a lack of adequate operational policies in education settings (Naidoo, 2016). Anene et al. (2014), while investigating the implementation of e-learning in Nigerian universities, Anene, Imam & Odumuh (2014) claim that the main barriers to adopting e-learning are due to first-order (institutional) barriers and second-order (cultural) barriers. The institutional hindrances involve access to ICT equipment and facilities, teacher professional development and technical support, while cultural barriers encompass teachers' attitudes and students' commitment. In the same vein, this dissertation confirmed that the integration of e-learning in Morocco encounters all the previously stated obstacles.

According to the research findings, lack of ICT facilities and e-resources is the first barrier that hinders the adoption of e-learning in the Moroccan HEIs. Developing curricula alone is not sufficient for a strategic education reform. In fact, it is of considerable significance to provide universities with the necessary didactic and technological equipment and facilities, as well as to offer extensive professional training for lecturers (Ministry of National Education, 2002). Nevertheless, the majority of public teacher respondents explained that educational settings are still equipped with marginally unsophisticated technological resources and inadequate infrastructure. They even stressed that the schools where they teach suffers from basic resources and facilities.

Scholars in the e-learning arena consider the poor investment in teacher professional development as another challenge that impedes the effective integration of e-learning systems in education settings (Badrul, 2005; Baporikar, 2013; Dauguenti, 2013). Although lecturers who were involved in this research showed their positive attitudes towards the pivotal role of e-learning, majority of them, (58%) affirmed that the education system does not provide them with the appropriate training and pedagogical support to effectively incorporate e-learning into their teaching. This is consistent with the findings of Donnelly & Mc Sweeney (2008) which established that many lecturers and learners do not have the adequate ICT skills because most of them have not been trained to understand, operate, and apply e-learning successfully.

Furuness (2018) claims that in-service and pre-service education allows instructors understand their needs and enhance their skills associated with teaching their students how to successfully get involved in the e-learning environment. In this sense, training support and teacher professional development are primary for the success of e-learning initiatives. In other words, incorporating e-learning technology into classroom practices involves training strategies to promote teachers' motivation, preparedness, confidence, interest, and knowledge.

Indeed, teachers' lack of ICT skills and knowledge is one the main barriers of not integrating e-learning into classroom settings. Although (42%) of the teacher-respondents received training on e-learning, they still believe that their digital literacy is not at the level it should be in order to incorporate e-learning into their teaching. This is consistent with several research studies such as (Beisser & Sengstock, 2018; Boswell, 2016; Cookson, 2015) that confirmed that successful e-learning depends heavily on the instructor's digital competencies and professional development. Accordingly, faculty needs more training on ICT integration approaches and ICT skills to effectively adopt the e-learning tools into their lessons.

On the other hand, experts in the field of e-learning confirm that the fulfillment of an effective e-learning environment is not only a matter of skills and training, but it is also linked to the engagement and motivation of the teacher and students (Garrison, 2011). Graham & Hewett (2009) state that the most serious impediments for most instructors to adopt e-learning into their teaching practices are linked to lack of ICT resources, lack of technical support, and lack of teacher training. Besides, the same study reveals that teachers' positive attitudes and motivation to teach using e-learning are among the primary factors that may promote the integration of this approach in educational contexts.

The present study confirmed the same findings whereby the majority of the surveyed teachers supported the significant role of adopting e-learning as a component within the university system. Although e-learning is not formally integrated in the educational program, the majority of participants (76%) showed their readiness and motivation to incorporate this modern approach into their teaching to support students' learning. Nonetheless, few others (24%) were skeptical. This category of lecturers explained that they are not qualified to engage in educational technology. That is, having constrained ICT skills, faculty members might feel less confident, more frustrated, and sometimes frightened of adopting new pedagogical practices (Gray & Smith, 2007). As already mentioned in chapter one, Ardito et al. (2004) state that an effective 'e-teacher' should be techno-savvy, teachers in the digital age should have the ability to understand and fully participate in the digital world in order to direct e-learning activities successfully and then promote learners' competencies allowing them to get involved in collaborative learning experiences. In this respect, a teacher-respondent claimed that "the university teacher is expected to embed ICT in teaching since we are living in a world that is determined by technology". It is necessary for lecturers to recognize the evolving nature of technology and its role in enhancing and facilitating the teaching and learning processes. E-learning is primarily established to support learners' critical thinking and autonomous learning skills and thus, offers them opportunities to be actively involved in making decisions (Baporikar, 2013).

Similarly, without adequate technical support, lecturers are not expected to overcome the obstacles preventing them from adopting e-learning in their teaching (Du, Liu, & Brown, 2009). In fact, sufficient technical support or maintenance is important to ensure that teachers can use e-learning easily and that any initial issues are dealt with efficiently (Shraim, 2018). In Gray and Smith's study (2007), technical issues were found to be a serious hindrance for university teachers. A further study by Shelly, Cashman and Gunter (2007) confirms that lack of ICT assistance in educational settings might discourage faculty from adopting e-learning in the classroom due to the fear of the equipment breakdown during a lecture. In general, several studies have identified technical issues as one of the critical factors that impede or encourage faculty members to use e-learning (Olaniran, 2009; Penalvo, 2007; Shanker & Hu, 2008; Sorial & Noroozi, 2010).

In the study mentioned earlier, findings revealed that technical support is one of the barriers that influenced the introduction of e-learning by lecturers. One of the teacher-respondents claimed "I admit that once I used the projector to deliver a lecture and guess what! 10 minutes later it was no longer working! I tried to fix it but in vain since I could not detect the source of the problem". Accordingly, not being able to deal with technical problems, lecturers will be discouraged from using e-learning tools due to fear of equipment failure. Therefore, they become frustrated resulting in their unwillingness to use e-learning in their pedagogical practices.

Although encountered with many obstacles that prevent them from incorporating e-learning into the classroom, the surveyed teachers showed high level of awareness towards its relevance in higher education settings. Most of the lecturers reported that including e-learning in pedagogical contexts motivates learners and get them actively engaged in the learning process. One of the teachers explained: "when I use multimedia learning tools, I notice that my students become more enthusiastic which allows them to control and manipulate the course content and thus become fully engaged in knowledge construction". Nowadays, students are constantly exposed to a considerable amount of information technologies; therefore, teaching and learning should take into account learners' needs so as to select the instructional strategies that increase students' motivation, achievement, and performance. In this sense, educational programs should be based on the constructivist and connectivism approaches that aim to engage all students by having them actively take part in the learning process whereby e-learning technology offers a valuable tool to allow such an active exploration to happen (Duschesne & McMaugh, 2018). In fact, when integrating e-learning systems into the curriculum, students tend to develop autonomous approaches to learning by taking personal responsibility for their own learning and thus becoming active lifelong learners.

In this respect, most of the respondents across both institutions reported that e-learning is the best pedagogical approach to encourage learners and engage them in effective learning experiences. Aside from the school environment, adopting e-learning also allows learners to transfer their competencies into other contexts (beyond the traditional classroom walls). Starkey (2012) claims that transfer from school to place of residence and back enables learners search for further challenging learning opportunities to reinforce their knowledge and ensure the continuity of learning.

In fact, one of the purposes of this thesis is to discover engineering students' perception of e-learning, which is an alternative to traditional classroom teaching and learning. The findings of the students survey showed that e-learning is perceived as having some pedagogical benefits over conventional face-to-face learning, which if adopted can promote teaching and learning in a better way. The majority of students perceived e-learning as a learning experience that provides them with some degree of convenience that is not necessarily the case if they were studying in the physical classroom setting alone. Student respondents have considerably agreed of the conveniences e-learning offers as revealed by experts in the e-learning arena.

To start with, (79.82%) of the respondents believe that e-learning is beneficial and useful. Among the arguments why e-learning is considered to be beneficial is that it allows learners fulfill their assignments more quickly as well as it enhances learning productiveness. This is since learners can have access to instructional resources, which are offered in the sort of electronic books and web links, which in turn enables them to concentrate on their studies without the need of going to the physical library to search for relevant course materials. This is consistent with a study carried out at the university of Cape Coast in Ghana, whereby the students had positive attitudes towards the usefulness and effectiveness of hybrid learning they took part in at this HE institution (Essel, Owusu-Boateng, & Saah, n.d.).

Aside from being considered as beneficial and useful, e-learning was perceived as having other benefits and flexibilities for studying engineering education. Among the advantages e-learning provides to learners is that it offers students the flexibility to complete their studies at their own pace, dependent on their personal situation (Gay, Salomoni,& Mirri, 2007). Such flexibility enables students to pursue education whenever and wherever they want and in their own special ways. The study findings revealed that majority of the engineering students are aware and agree to these conveniences e-learning offers over face-to-face learning. On the other hand, most of the respondents also believe that via e-learning, theycan perform better in quizzes and assignments without going to physical classroom settings to submit such tasks as well as they can learn more effectively via some e-learning courses.

Nonetheless, it must be noted that the benefits e-learning offers over traditional face-to-face learning can at times be a challenge; for instance, as students work at their own pace, they may feel a sense of isolation and remoteness due to lack of interaction with their peers and their teachers (Graham & Hewett, 2009). In this regard, the problem of not being able to communicate with their colleagues and instructors may engender disappointment, demotivation, and frustration due to such isolation. To address this problem, the students necessitate a higher motivation level to be effective at e-learning environments (Hever, Groot, & Hoppe, 2009). In this study, however, (87.8 %) of the student respondents showed high level of awareness towards the nature of e-learning and stressed its importance at the university. Besides, (91.7%) of the surveyed students believed that e-learning allows learning and communication to be practiced in real time, the same as it is in the conventional face-to-face setting. In other words, e-learning according to them, will encourage the students to communicate and exchange ideas with their fellows and teachers, which gives them a sense of belongingness as done in the physical classroom setting.

As learners perceive electronic learning as a convenient alternative to learning in the conventional classroom setting, it is necessary to take into account how e-learning is believed to be easy to use and manage. In this thesis, ease of use is defined as the degree to which college students perceive e-learning in terms of how easy it is to be used (Davis, Bagozzi, & Warshaw, 1989). The perceived ease of use in this context is the capacity of the students to master the e-learning platforms without undergoing regular training. Drawing on the analysis, the findings showed that (78%) of the respondents consider themselves capable of using an e-learning platform in which the majority (75%) do not think they need a specific training that helps them explore how it functions. Nonetheless, it should be mentioned that students' positive attitudes towards the ease of use of e-leaning platforms is insufficient to allow them to be effective at using them, considering that learners also need a certain degree of comfort and experience with computers and related technology to appropriately employ the e-learning platform. That is, without such digital skills and knowledge it becomes a barrier for the students to be successfully engaged in e-learning systems (Donnelly & Mc Sweeney, 2008). The researcher is of the view that the learners' mastery of digital skills is of paramount importance since being incapable of using computers; students will not benefit from the educational privileges e-learning offers over the traditional classroom setting.

In this study, the findings revealed that student respondents possess the basic ICT skills they need to easily take part in e-learning activities without any difficulties. This guarantees that the learners will not encounter any hindrances due to lack of technical knowledge, which generally generates frustration to users and becomes a hindering obstacle to e-learning integration (Singha, 2009). This is because, majority of the surveyed respondents (97%) have expressed their high level of comfort with technology as (76.7%) consider themselves technology experts which promotes and enhances their e-learning experience. This is in line with a study done at the University of Ghana, which aimed to determine learners' perception of integrating e-learning in the teaching-learning process; the study concluded that learnersentered the university with relatively good ICT knowledge, can take part in e-learning courses(Essel, Owusu-Boateng, & Saah, n.d.). These two findings demonstrate that learners with goodICT skills are able to participate in e-learning systems easily and will not be impeded because of lack of digital knowledge.

This research project aims to advocate the fact that the rate of accepting electronic learning is growing dramatically around the world (Thalhammer, 2014), and Morocco is not excluded from this e-learning acceptance. Yet, although all the student respondents surveyed in this research are learning through the old traditional methods, majority of them are eager to use e-learning in the future be it hybrid or fully online. Wang (2014) reported similar findings, based on the interviews with students, the researcher established that e-learning was considered as convenient and effective. The participants liked the fact that e-learning can be used anytime and anywhere. This is also consistent with a study conducted at the University of Cape Coast in Ghana, which concludes that among the options of pedagogical methods, learners favor e-learning modes of instruction. These study findings demonstrate that in the coming future a lot of learners will opt for more e-learning programs than traditional face-to-face classes. It appears thus, that learners are intending to try at least one mode of e-learning sooner or later. The researcher believes that since the study findings are having the same conclusions (learners' interest in e-learning both online education and blended learning), which functions as an open invitation to Moroccan higher education institutes and other academic establishments to reinforce their traditional pedagogical methods with e-learning including blended, web enhanced or completely online.

5.4. Summary

This chapter aims to offer substantial interpretation and discussion of the study results. It focuses on the main significant findings in relation to the research questions, hypotheses, and the literature review. The discussion of the quantitative results of the survey and the qualitative findings of the semi-structured interview confirms that the integration of e-learning in the Moroccan HEIs involves a number of factors including the institutional, the systematic, and the attitudinal. University teachers and engineering students positively perceive the integration of e-learning technology; nonetheless, the lack of institution support, professional development, adequate ICT infrastructure, technical support and digital skills hinder the adoption of this modern teaching approach in HE setting.

General Conclusion

1. Introduction

This conclusion reminds us of the research objective, principles, and methodology. It also epitomizes the major findings of the quantitative and qualitative data. Moreover, it covers some implications and limitations of the study, as well as suggestions and recommendations for further research. The contribution of the research study will be presented too focusing on the importance of e-learning in Moroccan higher education (HE).

The ultimate objective of this research study is to examine the implementation of e-learning in the Moroccan educational system, tertiary education in particular. The purpose of this inquiry is twofold. First, it aims at investigating the extent to which e-learning is manifested in higher engineering education, focusing on university teachers and students' perceptions and attitudes. Second, it sheds the light on the importance of implementing e-learning in Moroccan higher education, as it is considered as a modern strategy for disseminating knowledge in the digital age, granting an effective learning environment that varies from the classical teaching approach and providing further scopes to the teaching and learning of higher engineering education.

Providing high quality education is the objective of the current educational reforms; thus, offering good practices in e-learning imperatively lead to the delivery of high quality education. In this sense, to enhance the worth of education as a whole and of engineering education in particular, electronic learning is becoming an increasingly popular educational paradigm in teaching and learning; yet its adoption in the Moroccan context is still in its initial stages. Investigations of possible contributions of e-learning in education necessitate the examination of any new instructional tool to strengthen its use and its performance. Nonetheless, the emergence of modern computer technologies like e-learning systems considerably contributes to the enhancement of teaching and learning in higher education.

This study examines the use e-learning in the Moroccan context. It aims to investigate the extent to which e-learning is manifested in the Moroccan higher education institutions (HEIs). Likewise, this doctoral dissertation aims to detect the major factors impeding its successful implementation for teaching and learning higher engineering education. To clarify the implications of the adoption of e-learning in the Moroccan HE and its effectiveness in promoting high quality education, ten research questions (primary and secondary) and three hypotheses were formulated. Three research instruments were adopted in this research: a printed survey was administered to students in two Moroccan higher engineering institutes, anonline questionnaire was dispatched to university teachers at the same research sites, and finallya semi-structured interview was conducted with sixteen lecturers to get a clear understanding of the topic under investigation. These three research tools were employed to collect data both qualitatively and quantitatively, and hence answer the research questions and corroborate or reject the hypotheses.

Notably, this research study was conducted to verify whether ICT, namely e-learning helps in the process of effective teaching and learning higher engineering education. To address the issue, the thesis was divided into five chapters. The introduction covered the key concepts used in the study and the basic components that are linked to e-learning implementation in higher education. Those components are significantly needed to pave the way for a profound knowledge of the topic under investigation. Some former research have already highlighted the integration of e-learning abroad, often to refer to its effectiveness in supporting teaching and learning around the globe. A review was provided so as to shape the research; the purpose of the study was presented, then the research problem has been developed in connection to the research questions and hypotheses underlying the research. Besides, the research methodology adopted in this dissertation was briefly introduced.

Chapter one reviewed the literature pertaining to the integration of e-learning in higher education. Therefore, in order to provide the basics for understanding e-learning, Information and Communication Technologies (ICTs) were mainly determined and electronic learning was accurately defined. A section was dedicated to the history and features of e-learning as well as a thorough explanation of the online learning platforms and their role in the dissemination of educational information. Additionally, the paper provided a synopsis of the methods of teaching engineering and those to be used in the new educational paradigm. The students' learning characteristics and different learning styles were identified and the teachers' missions and functions in the physical learning environments and e-learning settings were presented. A section about assessment methods was deeply explained and the last section dealt with the theoretical framework of the research study. It addressed key principles and samples of important learning theories to determine the main components in implementing e-learning technology within the curriculum of the 21st century higher education; at the same time, it highlighted the preceding experiences of implementing e-learning in Moroccan education and in different nations as well.

The second chapter provided an overview of the research methods, design, tools, and the instruments employed in the gathering and analysis of the data with the objective to explain the various stages in the research process. In broad terms, the research methods, techniques and instruments were thoroughly explained and profoundly examined. Besides, the chapter offered more description and detailing of the printed and online surveys as well as the interview's layout. Likewise, the variables were approached so as to examine their reliability and viability in connection to the research questions. Eventually, the sorts and the forms of the adopted questions were discussed in a thorough analysis of establishing valid research tools.

Chapter three was dedicated to presentation of findings and data analysis of the paper-based survey. For the printed questionnaire, the Statistical Package for Social Sciences (SPSS) was adopted for a statistical analysis. Both descriptive statistical techniques (percentages, standard deviation, means, frequencies, reliability analysis) and inferential statistics (Chi-Square tests, Spearman's Correlation tests, ANOVA tests, Multiple Correspondence Analysis, to cross tabulate and compare the results) were employed in this study.

Chapter four presented the findings of both the online questionnaire and the semi-structured interview. This chapter was split into two sections; the first section presented the findings of the web-based survey questionnaire, while the second one established the results of the main findings of the semi-structured interview. For the online questionnaire, the SPSS was adopted for a statistical analysis of the quantitative data. As far as the interview is concerned, a thematic content analysis method was used to categorize and interpret the qualitative data.

The fifth chapter was devoted to the discussion of the major findings. This chapter was divided into three sections; the first section presented a summary of the main findings, the second section provided a discussion of findings in relation to the research questions and hypotheses and the third section dealt with a discussion of the findings in the light of the literature review. Eventually, a general conclusion provided a holistic overview of the entire study. It covered the summary, implications, limitations, recommendations of the study and suggestions for further research.

2. Main Research Findings

The results obtained from the QUAN and QUAL research methods offered the principle factors that should be taken into account for a successful e-learning implementation in higher education. Therefore, the findings showed significant facts about electronic learning and indicated some possible areas for future research. Typically, technology-enhanced learning is now considered as the focal point in higher education, it is becoming a major vehicle for getting and transferring knowledge. Mering, Ciong, & Then (2007) claim that "the paramount benefit of any e-learning program is the ability to extend the learning process beyond the four walls of the classroom, thus allowing participants to engage in learning anytime and anywhere" (p. 268).

This dissertation raises a number of issues pertinent to e-learning. It aims to offer a comprehensive approach that contributes significantly to our understanding of e-learning implementation in Morocco from various angles, namely, institution, teacher, and student, shedding the light on university teachers' perceptions and attitudes as main predictors for the adoption of this new paradigm in HE settings. The findings of the web-based survey and the semi-structured interview indicate that the practice of e-learning in Morocco remains in its early stage. Although Morocco has launched many initiatives and made several efforts in recent years to promote the role of information and communication technologies (ICTs) in the teaching and learning processes, the country has not yet succeeded in considering the integration of e-learning as an official academic component. Based on the respondents' testimonies, the HE curriculum follows some conventional and rigid paradigms that impede the educational advancement and prevent both educators and learners from being prepared to meet the challenges of the 21st century.

According to the research findings, a number of obstacles deter the adoption of e-learning. The major impeding factors are the lack of ICT infrastructure, absence of technical support, and lack of digital skills and training. Such results confirm former studies, which claim that the successful integration of e-learning requires a solid base in HE settings by providing the necessary equipment and resources. Moreover, it is imperative to equip lecturers with adequate ICT skills to perform proper e-learning practices by offering ongoing professional training programs.

On the other hand, despite the lack of convenient and supportive learning conditions to adopt e-learning, university teachers showed positive attitudes and strong motivation to use this modern approach in their pedagogic practices. They showed high awareness towards technology usage in teaching and learning in order to produce high skilled learners ready to join today's modern workforce. E-learning is manifested in HE settings due to the teachers' willingness to integrate this approach as a modern tool that improves students' outcomes and performances. The implementation of e-learning as an entirely new learning environment increases students' engagement by becoming active learners and more independent than in the traditional educational setting.

Considering the paper-based questionnaire conducted for this research, the findings demonstrated that e-learning is an effective alternative medium of education for students. First, today's students are tech-savvy learners who use technology in almost every aspect of their lives including education, which implies that they are formerly prepared to employ e-learning tools for educational purposes. In fact, students use various online tools for learning objectives including virtual worlds, synchronous and asynchronous chat tools to get more useful information and to connect with different learning groups. Moreover, some of them are even enrolled in some online courses. The questionnaire statistical analysis found that engineering students are no longer satisfied with the conventional teaching methods and are eager to use technology in their classes. They showed high willingness and motivation to use e-learning in learning engineering and reported high expectations concerning the effectiveness of this new teaching approach. Besides, as members of the "Net-Generation", learners are accustomed to high-tech gadgets, use the Internet on a daily basis, and are always up-to-date with new technology innovations, which help them develop appropriate digital skills. These skills would subsequently ensure effective and productive use of e-learning.

Technology-enhanced learning is still in its early stages in Morocco; therefore, the present research paper mainly focuses on the examination of the various obstacles that impede the adoption of e-learning, alongside the important factors and determinants that promote its successful implementation in higher education settings. Martinez-Caro (2019) claims that "e-learning may help to open up new channels for the traditional teaching of engineering but there are many questions about what makes e-learning an effective and satisfactory method… in the field of engineering" (p. 572). The main factors that add value to the efficiency of education in the e-learning environment are the learning material, technical support, students and teachers' characteristics, and information technology (IT). Those factors have been profoundly examined in this research project, and the major findings demonstrated that e-learning could be as efficient as traditional ways of teaching if the adequate and necessary infrastructure is offered.

This study addressed the instructional methods of teaching engineering education, as it offered suggestions and recommendations to overcome the limitations of traditional education by implementing e-learning as an alternative or complementary to the classical teaching methods. Consequently, one can assume that in contrast to the conventional education method, the adoption of e-learning technology can grant significant benefits due to its accessibility, quick delivery, and facilitated sessions or lectures. This research project presents an overall demonstration of the extent to which e-learning can facilitate the transformation of Higher Education Institutions (HEIs) in order to achieve high quality education. Actually, majority of the Moroccan universities seem to be lacking the adequate ICT facilities, professional training and technical support, which are considered key factors for successful e-learning implementation.

There are some other conclusions that were also identified as a result of carrying out this doctoral dissertation. Overall, based on the research findings, the practice of e-learning in Morocco involves the participation and contribution of different operators, organizations, and institutions. Therefore, policy-makers and stakeholders in the field of education should prepare action plans to meet the necessities of the digital age. Based on the assumption that ICT in general and e-learning in specific prove effective in enhancing the learning outcomes of students, its use in a country like Morocco is advisable and recommended.

3. Implications of the Study

This research paper represents a significant contribution to higher engineering education through e-learning practices. The study has carefully examined the use of e-learning in higher education (HE); it studied the significance of learners' readiness, technical assistance, faculty and learners' satisfaction, and institutional strategies. E-learning necessitates stronger commitment to improve the contemporary approach of teaching and perhaps to create a new paradigm of teaching engineering education.

Electronic learning grants encouraging prospects in teaching engineering education in HE. However, it is relatively hard for colleges to expand and extend their education and training programs through e-learning systems. Accordingly, instructional practices should be revised, teaching materials have to be reviewed, assessment methods and activities must be reconsidered, and finally technical and financial assistance must be provided. In Morocco, adequate computing technology is not available within the structure of all colleges and universities; nevertheless, the major challenge is how to match it with the teaching approach. This issue requires further and more deliberate examination to achieve the international status of colleges in advanced nations.

This research project has addressed the issue of implementing e-learning in teaching higher engineering education, and the major determinants and obstacles that hinder the integration of this new technology, as well as a systematic examination of the internal and external aspects including the learning strategy and material, the learners, educators and institutions. Admittedly, research in the field of e-learning in Morocco has not been totally explored. Yet, this research paper has confirmed that e-learning has beneficial impact on the knowledge and skills of both the educators and the learners. It can be adopted to supplement the campus-based courses, a blended learning model in which instructors transfer old skills to new teaching methods where learners are provided more chances to gain experience inside and outside the classroom and thus engage in self-directed learning.

The implications of the present research study are derived from the flexibilities and opportunities provided by e-learning and the potential that results in the learners’ level of learning engineering education. E-learning has become a more attractive alternative for learners because of its great flexibility; learners are more attracted by the alluring background colors and the graphic design. Thus, the adoption of e-learning can positively promote learners’ active involvement in the learning process. Although certain engineering teachers would assert that face-to-face instruction is better and contributes more to the effectiveness of engineering education. Today, "one size fits all" teaching approach does not exist anymore; there are no boundaries tied to time and place. Due to the exponential growth of new digital technologies, educational approaches must also be modified according to the personality and needs of the learner.

Besides, the results of the study can guide the departments of engineering to combine traditional learning with e-learning. Firstly, by dedicating specific training sessions about e-learning attributes, benefits and drawbacks, the latter will be a supporting structure for the operational aspect of tasks in e-learning environments. Secondly, by setting up seminars and workshops for learners and teachers, to strengthen their digital competencies, and increase their consciousness about the proper use of technology. Consequently, they become in charge of their own learning and development.

In this research project, the mixed methods approach was adopted through incorporating both QUAL and QUAN approaches; it was designed to provide accurate answers to the study's research questions that cannot be answered through qualitative or quantitative research alone. This research design can be carried out for further research to examine the improvement of students' performances in engineering departments and to identify how conventional educational tools and resources were incorporated within the e-learning setting.

Actually, e-learning systems are not always the perfect educational tools to support all types of instructional activities. First, the unavoidable technical issues (e.g., loss of Internet access, course navigation) become a challenge for both faculty and students. Moreover, the lack of adequate educational infrastructure for pedagogic practices is the biggest barrier to the successful implementation of a technology-enhanced learning environment, which makes the mission of the Moroccan universities very demanding, particularly with the lack of a national policy framework on e-leaning as well as the absence of technical expertise. Additionally, the lack of learners' consciousness in many instances stems from the absence of engagement on the part of students, which can be a real constraint to the operational side of employing e- learning.

For effective implementation of e-learning in teaching and learning engineering, the identified factors as determinants for its integration in HE must be given a serious consideration. That is, ensuring that the obstacles are reduced or completely eliminated through increasing access to adequate ICT equipment (computers, Internet connection, software, multimedia rooms, etc.); training teachers on how to use ICT in teaching; providing technical support and staff; teachers to change their negative attitudes towards educational technology; provide teachers with pre service and in service training and seminars on how to integrate e-learning in their pedagogical practices, and investing in ICT infrastructure and resources.

4. Limitations of the Study

Like all research projects, this doctoral dissertation has its own limitations. In fact, certain limitations were realized concerning the methodology of this study. One limitation with respect to the context of this research is that it was carried out only in one city in Morocco; therefore, this may affect the generalization of the results of the study to other cities. In other words, the findings may not be generalized to other cities or cultures. In fact, generalization should not be the primary objective in a research, rather, utilization of the results is of considerable significance, and it is up to the reader to determine how relevant the results are in their own context.

Although the research sample is small and the selected educational institutions are from the same city, the purpose of this study is not to generalize, but to offer a thoroughly contextualized understanding of the attitudes and challenges surrounding the use of e-learning in the Moroccan context. Finally, a major limitation of this dissertation is the fact that it focused only on one field of education “engineering education” but not on other disciplines. In this regard, more studies need to be conducted on other fields and why not drawing comparisons between the different processes and results. The obtained results are exclusively valid in the departments of engineering in the city of Marrakech. Yet, this research project still offers a notable contribution in the education sector with the aim of reaching high quality teaching and learning in Moroccan higher education institutions.

5. Suggestions for Future Directions

This research paper was carried out for the sake of tracking the continuous influx of technology with the intention of enhancing the teaching and the learning practices of Moroccan higher engineering education. Indeed, digital learning can improve the learners’ critical thinking as it can foster autonomous learning. The study has primarily examined the various attributes of participants (faculty & students), their prior knowledge and consciousness, their digital competencies, their readiness, their attitudes towards engineering education and ICT use, and their new responsibilities in the learning journey. Further research of scientific education may find the results pertinent and deserve further consideration and scrutiny through future research.

Likewise, future investigators might require students to provide their private access codes to gain access to the e-learning material in order to reach more information about technical, organizational, instructional and pedagogical practices in the e-learning environment, and to pursue the assessment process. In addition to that, the research questions were reconsidered in further discussion of the final findings, allowing for a more complete understanding of the main aspects of teaching and learning in e-learning settings. Consequently, various research areas have come into view in the phase of data examination, which can offer a favorable condition for further research in the field of e-learning within the Moroccan higher education institutions not only for engineering education, but also for other fields of education.

Moroccan colleges need to modify, adjust, adapt, and orient their teaching programs to meet new educational demands, and thus provide high quality instruction.

Electronic learning, social networks, digital college campuses, digital platforms, Web conferencing incorporate new directions in the pedagogical side of many institutions within higher education; therefore, research is a continuous practice that can meet new modes of consideration and inquiry; by introducing conceptual foundations which could give rise to practical frameworks. Obviously, this will shape the scopes of higher education for the generations to come. Certain areas for further research might examine the academic institutions, which have begun adopting e-learning in their teaching programs through years of practice, and by producing long-term implications of the implementation on learners' performances.

6. Summary

This chapter addressed the major contributions of the research paper. The findings of this research project offer an excellent base for further research from other various perspectives, which can shape the notion of quality in education through e-learning to guarantee continuous growth of the educational field. Aside from incorporating technology in the classroom, engineering departments must equip students with a high level of literacy and numerical skills for lifelong learning as well as for meeting the challenges of a technologically oriented labor market. Moreover, higher academic institutions must grant adequate working conditions and proper facilities for educators, which will motivate them to take part in the advancement of the quality of teaching and thus to achieve educational excellence. Similarly, the study offers important insights for the direction of future studies.

In fact, there is a pressing necessity to explore the practical side of e-learning by seeking solutions to remove the external and internal obstacles hindering its effective implementation. For instance, granting fellowships for faculty members and students to practice on an international scale, to provide opportunities for advanced trainings to improve their skills and knowledge and to benefit from the technological inventions of the developed nations to favor the development of education. Eventually, higher educational institutions must provide adequate technological infrastructure and necessary support resources to support e-learning activities as well as relevant training programs for both faculty and students. Overall, there is much research to be carried out in the e-learning and its implementation in educational contexts. This study, therefore, is carried out in effort to further solidify this new approach as a legitimate field of study.

REFERENCES

Abbot, C. (2003). *ICT: Changing education*. New York: Routledge Falmer.

Ajhoun, R., & Daoudi, N. (2018). Erratum to: Morocco. In S. Weber & S. Hamlaoui (Eds.), *E-Learning in the Middle East and North Africa (MENA) Region* (pp. 263-283). Springer. Cham

Abuhmaid, A. (2010). Embracing ICT by the Jordanian education system. In A. Salam & F. Albadri, *ICT acceptance, investment and organization: Cultural practices and values in the Arab world* (pp. 34-51). IGI Global.

Agarwan, P. G. (2012). *A half-century of Indian higher education: Essays by Philip G Altbach*. SAGE Publication: India. Retrieved on April, 12, 2017, from https://books.google.co.ma/books?id=mX0tBAAAQBAJ&printsec

Ait Hajji, K. (2018). ICT in education system: Comparing Morocco and Korea [PDF file]. Retrieved on June, 20, 2019, from https://www.researchgate.net/publication/333666176

Alam, F., Hadgraft, G. R., & Subic, A. (2014). Technology-enhanced laboratory experiments in learning and teaching. In F. Alam, *Using technology tools to innovate assessment, reporting, and teaching practices in engineering education* (pp. 289-302). IGI Global.

Ally, M. (2008). Foundations of educational theory for online learning. In T. Anderson (Ed.), *The theory and practice of online learning* (pp.15-44). AU Press.

Ally, M., & Samaka, M. (2016). Guidelines for design and implementation of mobile learning. In B.H. Khan, *Revolutionizing modern education through meaningful e-learning implementation* (pp. 161-176). IGI Global.

Alphin Jr, H. C., Chan, R. Y., & Lavine, J. (Eds.). (2017). T*he future of accessibility in international higher education*. USA: IGI Global.

Al-Shboul, M. & Alsmadi, I. (2010). Challenges of utilizing e-learning systems in public universities in Jordan. *International Journal of Emerging Technologies in Learning (iJET), 5*(2), 4-10.

Amilevieius, D. (2014). Critical issues in e-learning project management in the context of web technologies development. In V. Zuzevi, *E-Learning as a socio-cultural system: A multidimensional analysis* (pp. 172-186). IGI Global.

Anastas, W. J. (2000). *Research design for social work and the human services* (2nd ed). New York: Colombia University Press.

Anderson, G., & Arsenault, N. (2005). *Fundamentals of educational research*. London: Routledge Falmer.

Anene J., Imam, H., & Odumuh, T. (2014). Problem and prospect e-learning in Nigerian universities. *International Journal of Technology and Inclusive Education* (IJITE), *3*(2), 320–327. http://doi:10.20533/ijtie.2047.0533.2014.0041

Anis, H. (2011). E-learning in engineering education – general challenges and the Egyptian experience. [PDF file]. Retrieved on September, 07, 2017, from http://usir.salford.ac.uk/id/eprint/16997/1/paper_9.pdf

Ankomah, P., & Larson, T. (2014). ICT and skills transfer: The case for diaspora involvement in tourism development in Ghana. *In Management association, information resources,* (pp. 632-655). USA; IGI Global

Ardito, C., Costabile, F. M., Marisco, D. M., Lanzilotti, R., Levialdi, S., Plantamura, P. … Tersigni, M. (2004). Towards guidelines for usability of e-learning applications. *User-Centered Interaction Paradigms for Universal Access in the Information Society: 8th ERCIM Workshop on User Interfaces for All,* Vienna, Austria, June *2*(9), 185-202. DOI:10.1007/978-3-540-30111-0_16

Ariola, M. M. (2006). *Principles and methods of research* (6th ed). Philippine: Rex Book Store.

Arshavskiy, M. (2013). Instructional design for e-learning: Essential guide to creating successful e-learning courses. Your eLearning World.

Awosefo, N. (2018). Utilizing question and answer discussion forums to enhance learning in university health courses: Q&A online discussion forums for efficient e-learning. In C. N. Stevenson, *Enhancing education through open degree programs and prior learning assessment* (pp. 235-241). IGI Global

Badrul, K. H. (2005). *Managing e-learning: Design, delivery, implementation, and evaluation*. USA: Information Science Publishing.

Bahri, N. (2016). Investigating the impact of e-learning on learning English, *In European Conference on -learning* (pp. 56-65), Retrieved on April, 22, 2018, from https://www.srhe.ac.uk/conference2017/abstracts/0074.pdf

Balnaves, M., & Caputi, P. (2001). *Introduction to quantitative research methods: An investigative approach*. UK: Sage Publications Inc.

Banathy, H. B. (1991). *Systems design of education: A journey to create the future.* USA: Educational Technology Publications.

Baporikar, N. (2013). Effective e-Learning strategies for a borderless world. In I. Pelet, *E-learning 2.0 technologies and web applications in higher education* (pp. 22-44). IGI Global.

Bartuskova, A., & Krejcar, O. (2014). Design requirements of usability and aesthetics for e-learning purposes. In J. Sobecki, V. Boonjing & S. Chittayasothorn (Eds.), *Advanced approaches to intelligent information and database systems* (pp. 235-246). Springer, Cham.

Bates, A. W. & Bates, T. (2005). *Technology, e-learning and distance education.* New York: Psychology Press.

Beisser, R. S., & Sengstock, C. A. (2019). Investigating online instructors' experiences with constructivist pedagogy in a private university. In J. Keengwe, *Handbook of research on virtual training and mentoring of online instructors* (pp. 217-249). IGI Global.

Bejjar, A. M., & Boujelbene, Y. (2013). E-Learning and web 2.0: A couple of the 21st century advancements in higher education. In J. Pelet, *E-Learning 2.0 technologies and web applications in higher education* (pp. 1-21). IGI Global.

Bell, N., & Cowie, B. (2006). *Formative assessment and science education.* USA: Kluwer Academic Publishers.

Bentley, W. G. (2004). Problem-based learning. In A. J. Lowenstein & M. J. Bradshaw (Eds.), *Fuszard's innovative teaching strategies in nursing* (pp. 83-106). Jones and Bartlett Publishers.

Bentzen, R. W. (1985). *Seeing young children: a guide to observing and recording behavior*. Delmar Publishers

Bianchini, D., De Antonellis, V., De Nicola, A., & Missikoff, M. (2009). Towards a service-oriented e-learning framework based on semantics. *ECEL2009- 8th European Conference on E-Learning: ECEL, 18*(2), 81-90.

Blessing, T.M., & Chakrabarti, A. (2009). *DRM, a design research methodology*. London: Springer.

Boneu, M. J. (2011). Survey on learning content management systems. In N. F. Ferrer & J. Minguillon (Eds), *Content management for e-learning* (pp. 113-130). Springer Shop.

Boswell, C. (2016). Online educational experiences. In S. Cannon & C. Boswell (Eds.), *Evidence-based teaching in nursing: Foundation for educators* (pp. 175-210). Jones and Bartlett Learning.

Bourlova, T., & Bullen, M. (2005). The Impact of e-learning on the use of campus instructional space. In R. Lau, Q. Li & R. Cheung (Eds.), *Advances in web-based learning* (pp. 397-404). Springer.

Bourne, J., Broderson, M., & Dawant, A. (1995). *The influence of technology on engineering education*. USA: CRC Press, Inc.

Brender, J. (1997). *Methodology for assessment of medical it-based systems: In an organizational context*. Netherlands: IOS Press.

Bird, D. K. (2009). The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation- a review of current knowledge and practice. *Natural Hazards and Earth System Sciences 9*(4), 1307–1325. https://nhess.copernicus.org/articles/9/1307/2009/nhess-9-1307-2009.pdf

Bridget Mondt LEC Portfolio (2017). Retrieved on February, 10, 2017, from http://bridgetmondtlecportfolio/designing-a-class-discussion.

Brooks-Young, S. (2002). *Making technology standards work for you: A guide for school administrators.* International Society for Technology in Education (ISTE). Retrieved on August, 20, 2017, from https://books.google.co.ma/books?id=2VHe01tWQgcC&printsec

Buzetto-More, A. N. (2017). *Advanced principles of effective e-learning*. US: Informing Science Press.

Chambliss, F. D., & Schutt, K. R. (2012). *Making sense of the social world: Methods of investigation* (4th ed). USA: Sage Publications.

Chandrakar, M., Biswal, A. (2006). Expertise through infotech reality: Some reflections on technotronoic education in Indian schools. In B. C. Mahapatra, *Education in cybernetic age* (pp. 42-53). Sarup & Sons.

Cheung, C. K., & Xu, W. (2016). Promoting media literacy education in China: A case study of a primary school. *International Journal of Adolescence and Youth, 21*(2), 215-217. Doi: 10.1080/02673843.2013.821078

Clark, K. D. (2000). Urban middle school teachers' use of instructional technology. *Journal of Research on Computing in Education, 33*(2), 178–195. Doi: 10.1080/08886504.2000.10782308

Clarke, J. N., Caddik, N., & Frost, N. (2016). Pluralistic data analysis: Theory and practice. In B. Smith & A. C. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and exercise* (pp. 368-381). Taylon & Francis.

Clarke, M., & Madaus, G. (2012). Old and new in student evaluation. In T. Kellahan & D. L. Stufflebeam (Eds.), *International handbook of educational evaluation: Part one: Perspectives/part two: Practice* (pp. 485-600). Kluwer Academic Publisher.

Clarke, W. L., & Watts-Taffe, S. (2015). *Educating literacy teachers online: Tools, techniques, and transformations*. New York: Teachers College Press.

Conole, G (2013). *Designing for learning in an open world*. UK: Springer.

Cookson, S. P. (2015). Creating online courses step-by-step. In B. H. Khan & M. Allam (Eds.), *International handbook of e-Learning volume 1: Theoretical perspectives and research* (pp. 181-196). Routledge.

Cramb, A. R., & Purcel. T. (2001). *How to monitor and evaluate impacts of participatory research projects: A case study of the forages for smallholders project*. Colombia: International Center for Tropical Agriculture.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approaches* (3rd ed.). USA: SAGE Publications, Inc.

Czaja, R., & Blair, J. (2005). *Designing surveys: A guide to decisions and procedures* (2nd ed). USA: Pine Forge Press.

Danaher, P., Gururajan, R., & Hafeez-Baig, A. (2008). Transforming the practice of mobile learning: Pomoting pedagogical innovation through educational principles and strategies that work. In H. Ryu & D. Parson, *Innovative mobile learning: Techniques and* *technologies* (pp. 24-46). IGI Global.

Daugenti, W. T. (2009). *Edu: Technology and learning environments in higher education.* New York: Peter Lang Publishing.

Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. Management Science, 35(8), 982-1003. Retrieved on 23 March, 2019 from http://www.jstor.org/pss/2632151

De Leeuw, D. U., Hox, J. J., & Dillman, A. D. (2012). The Cornerstones of survey research. In D. De leeuw & D. A. Dillman, *International handbook of survey methodology* (pp. 1-17). Routledge.

De Satgé, R. (2002). *Learning about livelihoods: Insights from southern africa*. UK: Oxfam GB.

DePablos, C. (2008). Shared networks in technology education. In T. A. Lawrence, *Encyclopedia of information technology curriculum integration* (pp. 758-775). IGI Global.

DePablos, O., Tennyson, R., & Lytras, D. M. (2014). *Assessing the role of mobile technologies and distance learning in higher education*. USA: Information Science Reference. Retrieved on June, 12, 2017, from https://books.google.co.ma/books?id=FigdBgAAQBAJ&printsec

DePauw, P. K. (2019). Evolving landscape of global higher education: Challenges and opportunities. In A. Badran, E. Baydoun & R. J. Hillman (Eds.), *Major challenges facing higher education in the Arab world: Quality assurance and relevance* (pp-124-132), Springer. Retrieved on August, 21, 2017, from https://books.google.co.ma/books?id=UrqODwAAQBAJ&pg

DePietro, P. (2012). Transforming education with new media: Participatory pedagogy, interactive learning and web 2.0. *International Journal of Technology, knowledge and Society, 2*(6), 1-11.

Donnelly, R., & McSweeney, F. (2008). *Applied e-learning and e-teaching in higher education*. USA & UK: Information Science Reference.

Dron, J. (2007*). Control and constraint in e-learning: Choosing when to choose.* USA & UK: Idea Group Publishing.

Drucker, F. P. (2011). *The New realities*. USA & UK: Transaction Publisher.

Du, J., Liu, Y., & Brown, L. R. (2009). The Key elements of online learning communities. In H. H. Yang & S. C. Yuen, *Handbook of research on practices and outcomes in e-learning: issues and trends* (pp. 61-75). IGI Global.

Du Plooy, M. G. (2002). *Communication research: Techniques, methods and applications*. South Africa: Juta & Co. Ltd.

Duran, P. & Gonzalez, A. (2018). Practical operating educational solutions. In S. V. Tayal, M. Blaivas & T. R. Foster (Eds.), *Ultrasound program management: A comprehensive resource for administrating point-of-care, emergency, and clinical ultrasound* (pp. 301-316). Springer.

Durgin, J. P., & Pilla, L. (2015). Using market research as the basis for successful content product decisions. In W. J. Gibbs & J. Mckendrick, *Contemporary research methods and data analytics in the news industry* (pp. 152-169). IGI Global.

Duschesne, S., & McMaugh, A. (2018*). Educational psychology for learning and teaching* (6th ed). Australia: Cengage Learning Australia.

Elander, R., K. (2016). “I’m here for you”: Instructor presence online. In S. Agustino. *Creating teacher immediacy in online learning environments* (pp. 55-75). IGI Global.

E-learning Concept (2017). Functions and Tasks of E-learning. Retrieved on February, 16, 2017, from http://www.dreamstime.com/stock-photo-e-learning-concept-handwriting-wordsthirteen

Elhassani, E. M., Alami, A., Faoubar, M., & Zaki, M. (2016). The integration of information & communication technology in secondary education institutions in Morocco: The evaluation of academic achievement & the assessment of the administrative management through MASSAR system, *British Journal of Education*, *4*(3), 53-76. Retrieved on January 12, 2019, from https://www.researchgate.net/profile/Anouar_Alami2/publication/311563117

EMSI. (2016). Retrieved on July, 18, 2020, from https://www.emsi.ma/decouvrir-lemsi2/

ENSA. (2016). Cadi Ayyad Universty. Retrieved on July, 17, 2020 from http://www.ensa.ac.ma/ensa.php

Eschenbach, N. (2017). *Measuring performance in freight transport. A structure literature review*. New York: GRIN Verlag.

Essel, R., Owusu-Boateng, W. & Saah, A.A. (2008). Effect of distance learner-perception of course materials on access to learning for professional development: A case study of Centre for Continuing Education, University of Cape Coast, Ghana. Retrieved on, March, 04, 2019 from: http://wikieducator.org/images/b/b9/PID_737.pd

Fife, W. (2019). *Counting as a qualitative method: Grappling with the reliability issue in ethnographic research*. Switzerland: Springer Nature.

Fox, A. M., & Hackerman, N. (2003).Characterizing and mobilizing effective undergraduate teaching. In national research council, division of behavioral and social sciences and education, *Evaluating and improving undergraduate teaching in science, technology, engineering, and mathematics* (pp. 25-40). The National Academies.

Frankland, S. (2007). Perspectives of teachers and students towards assessment. In S. frankland (Ed.), *Enhancing teaching and learning through assessment: Deriving an* *appropriate model* (pp. 63-77). Springer Shop.

Freitas, D. S., & Jameson, J. (2012). *E-learning reader*. New York and London: Continuum International Publishing Group.

Friesen, N. (2009). *Re-thinking e-learning research: Foundations, methods, and practices*. New York: Peter Lang Publishing.

Friis, R. H., & Sellers, T. A. (2004). *Epidemiology for public health practice* (3rded). USA: Jones & Bartlett Publishers.

Furuness, S. (2018). Preparing teachers for the visual middle level classroom. In B. B. Eisenbatch & P. Greathouse (Eds.), *The Online classroom: Resources for effective middle level virtual education* (pp. 41-60). Information Age Publishing.

Garcia, E., Brown, M., & Elbeltagi, I. (2012). The changing roles of staff and student within a connectivist educational blog model. *ECEL2012-The Proceedings of the 11th European Conference on E-Learning 2(9)*, 165-174.

Gay, R. G., Salomoni, P., & Mirri, S. (2007). E-learning. In M. Freire & M. Pareira. *Encyclopedia of internet technologies and applications* (pp. 179-184). IGI Global.

Garrison, R., & Anderson, T. (2003). *E-Learning in the 21st century: A framework for research and practice.* London & New York: Routlege Falmer.

Garrison, R. (2011). *E-Learning in the 21st Century: A framework for research and practice* (2nded). London & New York: Routledge.

Ghoulam, K., Bouikhalene, B., Harmouch, Z., & Mouncif, H. (2016). The implementation of a cloud system for electronics learning in a Moroccan public university. In *International Journal on Smart Sensing and Intelligent Systems, 9*(4), 2051-2068. http://doi10.21307/ijssis-2017-952

Gong, S. (2009). The Application of process assessment in higher vocational education. In T. Zhang (Ed.), *Future computer, communication, control and automation* (pp. 363-374).

Springer.

Graff, E., Markkula, M, Demlova, M, Kuru, S., & Peltola, H. (2007). Innovative learning teaching methods. In C. Borri & F. Mafioli (Eds.), TREE: teaching and research in engineering in Europe: Re-engineering engineering education in Europe (pp. 51-64). Italy: Firenz University Press. Retrieved on September, 14, 2017, from https://books.google.co.ma/books?id=L_S2srf1Y4C&printsec

Graham, J. T., & Hewett, M. S. (2009). The Effects of e-learning on African American males: Three case studies. In B. Olaniran, *Cases on successful e-learning practices in the developed and developing world: Methods for the global information economy* (pp. 198-208). USA: IGI Global.

Gratton, C., & Jones, I. (2004). *Research methods for sport studies*. USA & Canada: Routledge.

Gray, L. D., Smith, E. A. (2007). *Case studies in 21st century school administration: Addressing challenges for educational leadership*. United State of America: Sage Publications, Inc.

Grazello, C., & Kuhn, S. (2016). Governing the multilevel transition. In T. Sauer, S. Elsen & C. Garzilo (Eds.), *Cities in transition: Social innovation for Europe's urban sustainability* (pp. 204-220). Routledge.

Green, W. L., Ottoson, M. J., & Roditis, L. R. (2020). Evidence-based public health management and practice. In L. Shi & J.A. Johnson (Ed.), *Public health administration: Principles for population-based management* (pp. 473-492). USA: Jones & Bartlett Learning. Retrieved on April, 10, 2020, from https://books.google.co.ma/books?id=VcX2DwAAQBAJ&pg=PA476&dq

Haghi, K. A., & Noroozi, B. (2016). The development and applications of e-learning technology standards. In R. Luppicini & A. Haghi (Eds.), *Education for a digital world:*

Present realities and future possibilities (pp. 1-24). New Jersey: Apple Academic Press.

Handur, S. V., & Naragung, G. J., & Kalwad, D. P. (2014). SUCC tool kit: An activity in data structure laboratory. *Proceedings of the International Conference on Transformations in Engineering Education, 5*(7), 395-406.

Harasim, L. (2017). *Learning theory and online technologies* (2nd ed.). New York: Routledge.

Hardman, E. (2016). Meeting the professional development needs of special educators in the 21st Century Classrooms. In M. Avgerinou & S. Gialamas, *Revolutionizing k-12 blended learning through the i²flex classroom model* (pp. 52-68). USA: IGI Global.

Harlen, W. (2007). *Assessment of learning*. India: Sage Publications.

Harpe, B., & Peterson, F. (2009). The theory and practice of teaching with technology in today's colleges and universities. In C. Payne, *Information technology and constructivism in higher education: Progressive learning frameworks* (pp.27-42). USA & UK: IGI Global.

Harry, K. (2002). *Higher education through open and distance learning*. London and New York: Routledge.

Hathaway, M., & Spidalieri, F. (2018). Kingdom of Morocco cyber readiness at a glance. Retrieved on June, 04, 2019, from https://www.potomacinstitute.org/images/CRI/CRI_Morocco_Profiledigital.pdf

Henry, T. G. (1990). *Practical sampling*. USA: Sage Publications.

Herrington, J., Reeves, T. C., & Oliver, R. (2009). *A guide to authentic e-learning*. New York & London: Routledge.

Hever, R., Groot, D. R., & Hoppe, U. H. (2009). Implementing technology-facilitated collaboration and awareness in the classroom. In B. Schwarz, T. Dreyfus, & R. Hershkowitz (Eds.), *Transformation of knowledge through classroom interaction* (pp.130-142). London & New York: Routledge.

Heywood, J. (2005). Engineering education: Research and development in curriculum and instruction. New Jersey: John Willey & Sons, Inc.

Hobbs, R. (1998). The seven great debates in the media literacy movement. *Journal of Communication, 3*(6), 16-32. Doi:10.111/j.1460-2466.survey.tb02734.x

Horton, K. W. (2003). *Using e-learning*. USA: American Society for Training & Development.

Hui, Q. (2007).Using the e-learning platform and tools in teaching. In M. Iskander, *Innovative techniques in instruction technology, e-learning, e-assessment and education* (pp. 34-45). Springer.

Inglebey, E., & Oliver, G. (2008). *Applied social science for early years*. London: Sage Publications.

Inoue, K. (2007). University students' perceptions of computer technology experiences: Questionnaire results and analysis. In Y. Inou, *Technology and diversity in higher education: New challenges* (pp. 121-145). USA: Information Science Publishing.

International Society for Technology in Education (2017). *National educational technology standards for students* (2nd ed.), (n.p.). Retrieved on April, 13, 2018, from https://books.google.co.ma/books?id=CRd5ui2VGGwC&pg=PA2&dq

Inyang, K. (2017). *Doing academic research*. UK: Cambridge Scholars Publishing.

Iskandar, M. (2008). *Innovative techniques in instruction technology, e-learning, e-assessment and education*. Ney York: Springer. Retrieved on August, 21, 2017, from https://books.google.co.ma/books?id=ngQH8S7Zx0gC&printsec

Jaccard, J. (2001). *Interaction effects in logistic regression*. USA: Sage Publications.

Jochens, W., Merrienboer, J.V., & Koper, R. (2004). *Integrated e-learning: Implications for* *pedagogy, technology and organization*. London & New York: Routledge Falmer.

Jonker, J., Pennink, P. (2010). *The essence of research methodology: A concise guide for master and phd students in management science*. Netherlands: Springer.

Jung, I. (2019). Connectivism and networked learning. In I. Jung (Ed.), *Open and distance education theory revisited: Implications for the digital era* (pp. 47-55). Japan: Springer. Retrieved on October, 22, 2020, from https://doi.org/10.1007/978-981-13-7740-2

Kai, M. (2019). A new approach for language learning and changing the teacher's role in online education. In Y. Inoue-Smith, *Faculty roles and changing expectations in the new age* (pp. 1-17). USA: IGI Global.

Kale, K.V., Mehrotra, S.C., & Manza, R.R. (2013). *Advances in computer vision and information technology*. New Delhi, Bangalore & Mumbai: I. K. International Pvt Ltd.

Katz, H. R., Thomas, J. R., & Tront, G. J. (1995). New paradigms for engineering education using the national information infrastructure and electronically mediated instruction. In J. Bourne (Ed.), *The influence of technology on engineering education* (pp. 202-235). USA: CRC Press

Kehind, O. L., Chen, X., Ayodele, P. K., & Akinwale, O. (2011). Developing remote labs for challenged educational environments. IN A. Azad, M. Auer & V. Horward, *Internet accessible remote laboratories: Scalable e-learning tools for engineering and science disciplines* (pp. 332-352). USA: Engineering Science Reference.

Kelly, A. (2008). *Changing software development: Learning to become agile*. England: John Wiley & Sons.

Kennedy, G. L., Latham, G., & Jacinto, H. (2015). *Education skills for 21st century teachers: Voices from a global online educators' forum*, New York & London: Springer.

Kettani, D., & Moulin, B. (2015). *E-government for good governance in developing* *countries: empirical evidence from the eFez project*. UK & USA: Athem Press.

Khan, A. J. (2011). *Research methodology*. New Delhi: S.B. Nangia.

Khan, B. H., & Ally, M. (2015). *International handbook of e-learning volume 1: Theoretical perspectives and research*. New York and London: Routledge.

Khan, B. H. (2005). *Managing e-learning: Design, delivery, implementation, and evaluation*. USA, UK: Information Science Publishing.

Khan, P. K. (2017). Improving the quality of online learning environments: The value of an online specific design model. In K. Shelton & K. Pederson, *Handbook of research on building, growing, and sustaining quality e-learning programs* (pp. 277-300). USA: IGI Global.

Kim, W. (2006). Directions for web-based learning. *Advances in Web Based Learning 5th International Conference, 1*(9), 19-21.

King, P. K, (2009). Trends and lessons from the history of contemporary distant learning. In V. Wang, *Handbook of research on e-learning applications for career and technical education: Technologies for vocational training* (pp. 297-311). USA & UK: Information Science Reference.

Kingsley, B. & Roberston, J. (2020). *Your A to Z of research methods and statistics in psychology made simple.* UK: Oxford University Press. Retrieved December 09, 2020, from,

https://books.google.co.ma/books?id=Fb_1DwAAQBAJ&printsec=frontcover&hl=fr&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Kituyi, G., & Tusubira, I. (2013). A framework for the integration of e-learning in higher education institutions in developing countries. *International Journal of Education and Development using Information and Communication Technology, 9*(2), 19-36. Retrieved on May, 14, 2019, from

https://files.eric.ed.gov/fulltext/EJ1071350.pdf

Kottler, A. J., Zehm, J. S., & Kottler, E. (2005). On being a teacher: The human dimension. USA: Corwin Press.

Kozma, B. R., Belle, W. L., & Williams, W. G. (1978). *Instructional techniques in higher education*. USA: Educational Technology Publication, Inc.

Krishnan, S. (2012). Problem-based learning curricula in engineering. In M. Rasul, *Developments in engineering education standards: advanced curriculum innovations innovations* (pp. 23-40). USA: Information Science Reference.

Kroger, J. (2007). Identify formation: Qualitative and quantitative methods of inquiry. In M. Watzlawik & A. Born, *Capturing identity: Quantitative and qualitative methods* (pp. 179-198). University Press of America.

Kumar, C. R. (2008). *Research methodology*. India: APH Publishing Corporation.

Kumar, S. V. & Sundar, P. V. (2018). Impact of student engagement in online learning environment. In A.V. Kumar, *Optimizing student engagement in online learning environments* (pp. 1-27). IGI Global

Kwapy, J. (2018). Making sense of building online learning communities. In Management Association Information Resources, *Online course management: Concepts, methodologies, tools, and applications* (pp. 857-885). IGI Global

Laadem, M. (2016). *E-learning integration in higher education: Focus on Moroccan English departments* [Unpublished doctoral dissertation]. Moulay Ismail University.

Lakin, L. (2013). *Developing independent learning in science: Practical ideas and activities for 7-12 year olds*. Ney York: Open University Press.

Lakrami, F., Labouidya, O., & Elkamoun, N. (2019). Towards the development of a pedagogical approach using MOOCs in traditional classrooms to support teaching in higher education in morocco. In *International Journal of Information Science & Technology*, *3*(2), 1-28. Retrieved March 03, 2019, from https://www.researchgate.net/publication/332036522

Leavy, P. (2017). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. New York & London: The Guilford Press.

Lee, C., Jor, G., & Lai, E. (2005). *Web-based teaching and English language teaching: A Hong Kong experience.* Hong Kong: The Chinese University Press

Li, H. (2013). *Educational change towards problem based learning: An organizational perspective*. Denmark: River Publishers.

Li, W., Liu, Y. (2008). Personal knowledge management in e-learning era. *Technologies for E-Learning and Digital Entertainment: Third International Conference, Edutainment 1*(4), 200-205.

Liminou, M., Lyons, M., & Schermbrucker, L. (2015). Comparison of the traditional with a flipped classroom approach in a psychology module. *14th European Conference on E-Learning.* 15(3), 123-136.

Loosveldt, G. (2012). Face-to-face interviews. In E. De Leeuw, J, Hox & D. Dillman, *International handbook of survey methodology* (pp. 201-220). Taylor and Francis Group

Lucido, L. P., & Borabo, L. M. (1997). *Educational technology*. Katha Publishing.

Luminou, M., & Smith, M. (2012). The role of feedback in e-assessments for engineering education [PDF file]. Retrieved on February, 10, 2018, from https://link.springer.com/article/10.1007/s10639-012-9200-5

Lumsden, J. (2006). Online-questionnaire design guidelines. In R. Reynolds, R. Woods & J Baker. *Handbook of research on electronic surveys and measurements* (pp. 44-64). Idea Group Reference.

Mahendiran, P., & Gnanadevan, R. (2016). ICT enabled learning environment for slow learners. In R. Gnanadevan & R. Babu, *Emerging technologies to enhance learning among slow learners* (pp. 286-289).

Mahlangu, V., P. (2018). The good, the bad, the ugly, of distance learning in higher education. In Sinecen, M (Ed.), *Trends in e-learning* (pp. 17-30). London and USA: Intechopen. https://dx.doi.org/10.5772/intechopen.71183

Marinako, E., & Giousmpasoglou, C. (2014). M-learning in the Middle East: The case of bahrain. In P. Pablos, R. Tennyson & M. Lytras. *Assessing the role of mobile technologies and distance learning in higher education* (pp. 176-199). Information Science Reference.

Martin-kniep, O. G. (1999). *Capturing the wisdom of practice: Professional portfolios for educators*. USA: Association for supervision and Curriculum Development.

Martinez-Caro, E. (2009). Factors affecting effectiveness in e-learning: An analysis in production management courses. *Journal of Computer Application in Engineering Education*, *19*(3), 572-581.https://doi10.1002/cae.20337

Maxwell, A. J., & Wooffitt, R. (2005). *Qualitative research design: An interactive approach* (Vol.41) USA: Sage Publications.

McArdle, E. G. (2007). *Training design and delivery.* USA: American Society for Training & Development.

McLoughlin, C. (2012). Online instructors: Andragogical or pedagogical teaching. In V. Wang, *Technological applications in adult and vocational education advancement* (pp. 1-10). IGI Global

Mengel, S., Kuszpa, M., & De Witt, C. (2009). Mobile learning: Didactical scenarios in the context of learning on the job. In M. Ebner & M. Schiefner. *Looking toward the future of technology-enhanced education: Ubiquitous learning and the digital native* (pp. 222-244). IGI Global

Merril, N. (2011). Social media for social research: applications for higher education communications. In L. Wankel & C. Wankel (Eds.), *Higher education administration* *with social media: Including applications in student affairs, enrollment management, alumni relations, and career centers* (pp. 25-48). Emerald Group Publishing.

Michau, F., Gentil, S., & Barrault, M. (2001). Expected benefits of web-based learning for engineering education: Examples in control engineering. *European Journal of Engineering Education. 26*(2), 54-7.

Midkiff, B. R., & Thomasson, D. R. (1993). A practical approach to using learning styles in math instruction. USA: Charles & Thomas Publisher. Retrieved on September, 19, 2017, from https://books.google.co.ma/books?id=VDTYCQAAQBAJ&printsec

Mikolla, A. (2012). Perspectives for the future of the teaching profession. In H. Neimi, A. Toom & A. Kallioniemi, *Miracle of education*: The principles and practices of teaching and learning in Finnish schools (pp. 9-11). Springer

Miller, M. K. (2013). *Nonparametric statistics for social and behavioral sciences*. London: CRC Press.

Minimair, M. (2017). Collaborative computer algebra. In R. Pavelle, *Applications of computer algebra* (pp. 288-304). Springer

Ministry of National Education. (2002). *Al-kitabou-labyad* [The white book]. Rabat: Ministry of National Education. Retrieved from http://portail.men.gov.ma on April 29, 2020.

Mirkin, B. (2011). *Core concepts in data analysis: Summarization, correlation and visualization*. UK: Springer. https://doi10.1007/987-0-85729-278-2

Mitra, L. (2012). *Discipline your child: A guide to raising responsible and independent children*. USA: Xilibris Corporation.

Moeller, F. P. D., & Sitzmann, D. (2012). Online computer engineering: Combining blended e-learning in engineering with lifelong learning. In M. Rasul, *Developments in engineering education standards: Advanced curriculum innovations* (pp. 194-215). IGI Global.

Moeller, F. P. D., & Vakilzadian, H. (2012). Technology-enhanced learning standard through modeling and simulations into engineering study programs. In M. Rasul, *Developments in engineering education standards: Advanced Curriculum Innovations* (pp. 157-177). IGI Global.

Moise, G., Suditu, M., & Netedu, L. (2012). The implementation of the e-learning systems in higher education-sharing the work experiences from petroleum-gas university of Ploiesti. *Advances in Web-based Learning 11th International Conference, 2*(4), *21-38.*

Murray, R. T. (2003). *Blending qualitative and quantitative research methods in theses and dissertations*. USA: Corwin Press, Inc.

Naidoo, V. (2016). E-Learning and management education at African universities. In N. Baporikar, *Management education for global leadership* (pp. 181-201). IGI Global

Needham, D. (1999). *Business for high awards* (2nd ed). USA: Heinemann Educational Publishers).

Neelankavil, P. J. (2015). *International business research*. London & New York: Routledge.

Nelson, K. (2008). *Education skills for 21st century teachers: Voices from a global online educators' forum*. USA: Corwin Press.

NurSyamimi, N. R., & Noraffandy, Y. (2010). Blended learning: Overcome the weaknesses of e-learning and traditional approach [PDF file]. Retrieved April, 28, 2018, from https://pdfs.semanticscholar.org

Noroozi, B., Valizadeh, M., & Soria, A. G. (2010). Designing e-learning for engineering education in developing countries: Key issues and success factors. In D. Russell & H. Haghi, *Web-based engineering education: Critical design and effective tools* (pp. 1-19). Idea Group Inc.

Oermann, H. M, & Gaberson, B. K. (2014). Evaluation and testing in nursing education (4th Ed). USA: Bang Printing.

O'leary, Z. (2018). *Research question: Little quick fix*. UK: Sage Publications.

Olaniran, B. A. (2009). *Cases on successful e-learning practices in the developed and developing world: Methods for the global information economy*. USA: Information Science Reference.

Olivera, C. J., Navarro, P. A. & Vinuesa, S. T. (2012). E-learning for engineering, medical education and biological education. In A. Silva, E. Pontes, A. Guelfi (Eds.), *E-learning: Engineering, on-job training and interactive teaching*, (pp.107-138). InTech.

Oni, S. (2012). *Revitalizing Nigerian education in digital age*. USA: Trafford Publishing.

Oraki, S. (2018). The future of online learning and teaching in higher education. In A. Al-Sartawi, M. A., Musleh, K. Hussainey, A. Hannoon, A., & A. Hamdan, (Eds.) *Global approaches to sustainability through learning and education* (pp. 28-45). IGI Global.

Ornstein, C. A. (1990). *Institutionalized learning in America*. USA and UK: Transaction Publishers.

Osborne, M., Morgan-Klein, B. (2007). *The Concepts and practices of lifelong learning*. London and New York: Routledge.

Pallof, M. R., & Pratt, K. (2011). *The excellent online instructor: Strategies for professional Development*. John Willey and Sons.

Partee, H. M. (2002). *Cyberteaching: Instructional technology on the modern campus*. USA: University Press of America.

Pelet, J. (2013). *E-learning 2.0 technologies and web applications in higher education*. USA: IGI Global.

Penalvo, F.J. (2007). *Advances in e-learning: Experiences and methodologies*. New York: Information Printing, Inc.

Petrova, K., & Sinclair, R. (2008). E-learning value and student experiences: A case study. In F. J. García-Peñalvo, *Advances in e-learning: experiences and* *methodologies* (pp. 112-131). Information of Science Reference.

Pettenati, C. M, & Cigognini, E. M. (2009). Knowledge flow and learning design models towards lifewide e-learning environments. In N, Karacapilidis (Ed.), *Solutions and innovations in web-based technologies for augmented learning: Improved platforms, tools, and applications*, 110-129. IGI Global.

Piotrowski, M. (2010). What is an e-learning platform? In Y. Kats (Ed.), *Learning management system technologies and software solutions for online teaching: Tools and applications* (pp. 20-36). IGI Global.

Polio, C., & Friedman, A., D. (2016). *Understanding, evaluating, and conducting second language writing research*. NY & London: Routledge. Retrieved on March, 12, 2020, from https://doi.org/10.4324/9781315747293

Pratt, K., & Pallof, M. R. (2007). *Building online learning communities: Effective strategies for the virtual classroom*. United States: Willey and Sons.

Qorbani, D., Vanani, I. R., Sohrabi, B., & Forte, P. (2014). A hybrid analysis of e-learning types and knowledge sharing measurement indicators: A model for e-learning environment. M. Thomas (Ed.) *Pedagogical considerations and opportunities for teaching and learning on* the web, (pp. 60-70). IGI Global

Qu, K., & Zhong, X. (2014). The practical research about collaborative learning on the moodle. In S. Narayanasamy (Ed.), *International conference on social science and management (ICSSM 2014)*, (pp. 218-223). DEStech Publications, Inc.

Ragan, C. L., & Schroeder, R. (2013). Supporting faculty success in online learning. In G. Miller (et.al) (Eds.), *Leading the e-learning transformation of higher education: Meeting the challenges of technology and distance education*, (pp. 123-145). Stylus Publishing, LLC.

Rank, T., Millum, T., & Warren, C. (2011). *Teaching English using ICT: A practical guide* *forsecondary school teachers*. London, New York: Continuum International Press.

Rashad, A. M., Alia, A. A., & Youssif, R. A. (2008). E-assessment tool: A course assessment tool integrated into knowledge assessment. In Iskandar, M (Ed), *Innovative techniques in instruction technology, e-learning, e-assessment and education* (pp. 7-1). NY & USA: Springer. Retrieved on December, 21, 2017, from https://doi.org/10.1007/978-1-4020-8739-4

Razali, B. Z., & Trevelyan, J. (2012). An evaluation of students' practical intelligence and ability to diagnose equipment faults. K. M. Yusof, (Ed.) *Outcome-based science, technology, engineering, and mathematics education: Innovative practices* (pp. 328-349). IGI Global.

Razani, M. (2017). *Information, communication, and space technology*. London & New York: CRC Press. Retrieved on January, 12, 2017 from, https://books.google.co.ma/books?id=z2zRBQAAQBA

Reo, G. T., & Ortega, L. C. (2013). Online learning: Demotivators and motivators of faculty online teaching participation. In V. C. Wang (Ed.), *Handbook of research on teaching and learning in k-20 education* (pp. 460-474). IGI Global.

Rhema, A. & Miliszewska, I. (2010). Towards e-learning in higher education in Libya. *Issues in Informing Science and Information Technology 7*(1), 423-438. http://iisit.org/Vol7/IISITv7p423-437Rhema735.pdf

Rhema, A., & Miliszewska, I. (2014). Analysis of student attitudes towards e-learning: The case of engineering students in Libya. I*ssues in informing science and information technology (pp.* 169-190). Retrieved on June, 12, 2018, from http://iisit.org/Vol11/IISITv11p169-190Rhema0471.pdf

Riyami, B., Poirier, F., & Mansouri, K. (2017). Towards a hybrid learning model for the higher education system in Morocco. *Journal of English Language Teaching and*

Linguistics, 1(3), 203-214. https://doi10.21462/jeltl.v1i3.29

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed.). New York: Free Press. Retrieved from http://en.bookfi.net/book/1083892 on April, 24, 2020

Rubbin, A., & Babbie, E. (2010). *Essential research methods for social work* (2nd ed.). USA: Books/Cole Cengage Learning.

Ruona, E., A. (2005). Analyzing qualitative data. In R. A. Swanson & E. F. Holton, *Research in organizations: Foundations and methods in inquiry*, (pp. 233-264). Berrett-Koehler Publishers.

Ruhleder, K., & Twidale, B. M. (2004). Over-the-shoulder learning in a distance. In M. M. Kazmar, Learning, culture, and community in online education: research and practice, (Vol. 21) (pp.177-196). Peter Lang.

Rukhsana, A. (2012). Interpersonal health communication: an ecological perspective. In R. Obregon, & S. R. Waisbord (Eds.), *The handbook of global health communication*, (Vol. 29). (pp. 144-176). Hoboken, NJ: Wiley-Blackwell.

Rutherford, M., S. & Prytherch, C., Z. (2016). Assessment 'for' learning: Embedding digital literacy and peer-support of learning into an assessment. In M. M. Pinheiro (Ed.), *Handbook of research on engaging digital natives in higher education settings*, (pp. 121-153). IGI Global.

Sabin, T. (2012). *A teaching handbook for wiccans and pagans: Practical guidance for sharing your path*. USA: Llewellyn Worldwide.

Salmon, G. (2009). E-moderating. In P. L. Rogers, *Encyclopedia of distance learning*, (pp. 890-897). IGI Global.

Salmon, G. (2011). *E-moderating: The key to online teaching and learning*. USA & New York: Routledge.

Salvia, J., Ysseldyke, J., & Witmer, S. (2009). *Assessment: In special and inclusive education*. USA: Cengage Learning.

Sangra, A., Guardia, L., & Fernandez-Michels, P. (2009). Matching technology, organization and pedagogy in e-learning: Looking for the appropriate balance leading to sustainability and effectiveness. In M. Stansfield & T. Connolly (Eds.), *Institutional transformation through best practices in virtual campus development: advancing e-learning policies*, (pp. 95-114). IGI Global.

Sapargaliyev, D. (2014). Forced necessity: Moocs in post-soviet countries. In M. Ciussi, *Leading issues in e-learning research: Moocs and flip: What's really changing? for researchers, teachers and students.* Springer. Retrieved on April, 23, 2018, from https://books.google.co.ma/books?id=ElMJBAAAQBAJ&printsec

Scepanovic, S., Guerra, V., & Lubcke, M. (2015). Impact of technological advancement on the higher education curriculum and program development. In J. Lindsay, *Curriculum design and classroom management: Concepts, methodologies, tools, and applications*, (pp. 677- 696). IGI Global.

Schaller, B. (2005). *On-board and intercept transit survey techniques*. USA: Transportation Research Board.

Schensul, L. S., Schensul, J. J., & LeCompte, M. D. (1999). *Essential ethnographic methods: Observations, interviews, and questionnaires.* USA: Rowman & Littlefield Publishers, Inc.

Schneider, Z., & Fisher, M. (2012). Sampling data in quantitative research. In D. Whitehead, G. LoBiondo-Wood, & J. Haber, *Nursing and midwifery research: Methods and critical appraisal for evidence-based practice* (pp.184-19). Elsevier Health Sciences.

Schwandt, A. T. (2007). *The sage dictionary of qualitative inquiry* (3rd Ed.). USA: Sage

Publications, Inc.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (3rdEd). New York: Teachers College Press.

Sell, R., Seiler, S., & Ruutmann, T. (2012). Unified Remote and Virtual Lab Solutions for Engineering Education. In M. T. Restivo, A. Cardoso, & A. N. M. Lopes, *Online experimentation: Emerging technologies* (pp. 383-400). Lulu. com

Setati, M. (2005). Mathematics education and language: Policy, research and practice in multilingual south Africa. In R. Vithal, J. Adler, & C. Keitel (Eds.), *Researching mathematics education in south Africa: Perspectives, practices and possibilities* (pp.73-109). HSRC Press.

Shanker, M., & Hu. Y. M. (2008). A framework for distance education effectiveness: An illustration using a business statistics course. In S. Negash, M. Whitman, A. Woszczynski, K. Hoganson, & H. Mattord (Eds.), *Handbook of distance learning for real-time and asynchronous information technology education* (pp. 99-113). IGI Global.

Shelly, G. B., Cashman, J. T., & Gunter, G. (2007). *Teachers discovering computers: Integrating technology and digital media in the classroom*. Boston: Thomson Course Technology. Retrieved on January, 11, 2020, from https://books.google.co.ma/books?id=uQAGAAAAQBAJ&dq

Shi, H., & Witte, M. M. (2017). Self-directed language learning, Asian cultural influences, and the teacher's role. In F. G. Giuseffi (Ed.), *Emerging self-directed learning strategies in the digital age* (pp. 109-140). IGI Global.

Shirish, S. T. (2013). *Research methodology in education* (1stEd). USA: Lulu Publication. Retrieved on September, 14, 2018, from https://books.google.co.ma/books?id=IZG2BgAAQBAJ&pg=PA2&dq

Shraim, K. (2018). Palestine (West bank and Gaza strip). In S. Weber & S. Hamlaoui (Eds.), *E-Learning in the Middle East and North Africa (MENA) region* (pp. 263-283). Springer

Sikaraya-Turk, E. & Uysal, M. (2011).Survey research: Sampling and questionnaire design. In E. Sirakaya-Turk (Ed.), *Research methods for leisure, recreation and tourism* (pp. 94-106). CABI

Singh, M. S. (2019). *Advanced technology-assisted problem solving in engineering education: Emerging research and opportunities*. USA: ICI Global.

Singha, R., R. (2009). Implication of the shifting pedagogical paradigms from class instructions to e-learning. A. L. Kumar& M. R. Kumar, *Current scenario of transformation in teacher education* (pp. 30-37). Lulu. Com.

Siran, M. & Tripathi, P (2013*). Handbook of research on transnational higher education*. USA: IGI Global. Retrieved on August, 20, 2017, from https://books.google.co.ma/books?id=MuCWBQAAQBAJ&printsec

Sivaraj, R. (2019). Computational participation as a portal to collaborative stem. In P. H. E. Bull, & J.E. Keengwe, *Handbook of research on innovative digital practices to engage learners* (pp. 334-347). Information Science Reference.

Smith, J. K. (2010). *Practical tourism research*. UK: Cambridge University Press.

Sommer, T., Bach, U., Richert, A., & Jeschke, A. (2014). A Web-based recommendation system for engineering education e-learning solutions. In S. Jeschke, I. Isenhardt, F. Hees, & K. Henning (Eds.), *Automation, communication and cybernetics in science and engineering 2013/2014* (pp. 463-475). Springer.

Sorial, A. G. & Noroozi, B. (2010). Improvement of engineering students education by e-learning. In R. Luppicini, & A. K. Haghi (Eds.), *Cases on digital technologies in higher education: Issues and challenges* (pp. 150-163). IGI Global.

Sorin, G. W. (2008). *Expectations and demands in online teaching: Practical experiences: practical experiences*. USA: IGI Global.

Spitzlinger, R. (2006). *Mixed method research - qualitative comparative analysis*. Germany: GRIN Verlag.

Stangor, C. (2010). Research methods for the behavioral sciences (4th Ed). USA: Cengage Learning.

Starkey, L. (2012). *Teaching and learning in the digital age*. USA & Canada: Routledge.

Subheesh, N. P., & Sethy, S. S. (2019). Assessment and evaluation practices in engineering education: a global perspective [PDF file]. Retrieved on December, 13, 2017, from https://www.ejmste.com/download/learning-through-assessment-and-feedback-practices-a-critical-review-of-engineering-education-7786.pdf

Teddlie, C. & Onwuegbuzie, J. A. (2003). A Framework for analyzing data in mixed methods research. In A. Tachakkori, & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 351-366). Sage Publications.

Terry, J. A., & Faulk, R. D. (2012). Transformative learning in the online environment. In A. H. Morris, & D. R. Faulk, *Transformative learning in nursing: A guide for nurse educators* (pp. 138-154). Springer Publishing Company.

Thalhammer, V. (2014). E-Learning: an Opportunity for older persons. In B. S. Hertha, S. J. Krašovec, & M. Formosa (Eds.). *Learning across generations in Europe: Contemporary issues in older adult education* (pp. 47-57). Springer.

Thornton, A. & Koech, J. (2017). Building an e-learning center from the ground up: The challenges and lessons learned. In A. A. Pina, V. L. Lowell, and B. R. Harris (Eds.), *Leading and managing e-Learning: What the e-Learning leader needs to know* (pp, 73-86). Springer.

Tredgold, T. (1986). *Engineering infrastructure diagramming and modeling*. The National Academies Press. Retrieved on August, 21, 2017, from https://books.google.co.ma/books?id=AYFYVUGXpkMC&printsec

Turner, A. D. (2012). *Quality in higher education*. Sense Publisher. Retrieved from April, 30, 2017, from https://books.google.co.ma/books?id=2wcGUfVzSjIC&pg

Valiulis, V. A., & Valiulis, D. (2009). Engineering education quality assurance: The essential pillar of higher education reform in Lithuania. In P. J. Gray & A. S. Patil (Eds.), *Engineering education quality assurance: A global perspective* (pp. 191-199). Springer.

Ventura, M. D. (2014). Process, project and problem based learning as a strategy for knowledge building in music technology. In J. Vopava, V. Douda, R. Kratochvil, & M. Konecki (Eds.), *Proceeding of the multidisciplinary academic conference on education, teaching and learning* (pp. 36-42). Prague, Czech Republic.

Veermani, M. (2010). E-learning: A conceptual framework. *International Journal of Educational Research and Technology*, *1*(2), 20-24. https://d1wqtxts1xzle7.cloudfront.net/33573117/3_-_Elearning-with-cover-page.pdf

Vian, A., Shaik, A. & Aouad, G. (2013). An ontology of construction education for e-learning via the semantic web. In Dino, B (Ed.), *Teaching and learning building design and construction* (pp. 87-100). Earthscan. https://doi.org/10.4324/9781315065861

Walliman, N. & Buckler, S. (2008). *You dissertation in education*. Great Britain: Cromwell Press.

Wang, S. (2014). A practical Research of Hybrid Learning Mode of Teaching and Research Activities. In S. K. C. J. Fong, & Fong, S. K. C. J., & W. F. F. L. Wang, International Conference on Hybrid Learning and Continuing Education (pp. 68-79). Springer

Wang, J., Li, S., Fu, Y., Liu, S., & Jiang, H. (2016). Combining problem and lecture based learning for production system modeling and simulation course in industrial engineering education. In E. Qi, J. Shen & R. Dou (Eds.), *Proceedings of the 23rd International Conference on Industrial Engineering and Engineering Management 2016: Theory and Application of Industrial Engineering* (pp. 23-28). Atlantis Press.

Watkins, D. & Gioia, D. (2015). *Mixed methods research*. USA: Oxford University Press.

Watlington, D., Murley, R., Corneluis, A., & Kelley, T. (2014). Preparing educators for development of innovative teaching using mobile technology. In J. Keengwe, *Promoting active learning through the integration of mobile and ubiquitous technologies* (pp. 74-97). USA: IGI Global.

Watts-Taffe, S., & Clarke, W. L. (2014). *Educating literacy teachers online: Tools, techniques, and transformations.* New York: Teachers College Press.

Weber, S., A., & Hamlaoui, S. (2018). *E-Learning in the Middle East and North Africa (MENA) region*. Switzerland: Spring International Publishing. http://doi.org/10.1007./978-3-319-68999-9

Wedell, M. (2009). *Planning for educational Change**:** Putting people and their contexts first*. Great Britain: MPG Books, Cornwall.

Wellington, J. (2000). *Educational research: contemporary issues and practical approaches*. Great Britain: Biddles Ltd.

Whitcomb, A., & Clarke, G. (2000). *Heinemann office procedures for CXC*. Great Britain: Scotprint.

Williams, P., J., & Chen, H. (2008). Computer mediated communication and multimodal instruction in higher education. In S. Kelsey & K. St Amant (Eds.) *Handbook of research on computer mediated communication* (pp. 128-145). IGI Global.

Wilson, W. L. (2007). *Improving your elementary school: ten aligned steps for administrators, teams, teachers, families, & students*. New York: Eye on Education, Inc.

Wurdinger, D. S. (2012). *Time for action: Stop teaching to the test and start teaching skills*.

USA: Roman and Littlefield Education.

Yang, H. H. (2013). An integrated approach to developing visual literacy. In S. K. Cheung, J. Fong, W. Fong, & F. L. Wang (Eds.), *International conference on hybrid learning and continuing education* (pp.219-231). Springer.

Zhang, Y. (2011). Application of multimedia technology in reading lessons of college English teaching. In Y. Wang (Ed.), *Education and educational technology* (*Vol*. 108*)* (pp. 209-215). Springer Science & Business Media.

Zhao, H. (2011). Introducing ICT in a traditional higher education environment. In S. L. X. Huang, *Advances in computer science, environment, ecoinformatics, and education* (pp.129-133). Springer.

Zhao, J., Zhao, G., Wen, Q., Ma, L., Zhang, L., Mi, X., . . . Wu, X. (2012). A Study on improving e-learning in higher engineering education. In S. Sambath & E. Zhu (Eds.), *Frontiers in computer education* (pp. 27-32). Springer Science & Business Media.

Zigorous-Coe, I. V. (2012). A model for online instructor training, support, and professional development. In J. Keengwe (Ed.), *Virtual mentoring for teachers: Online professional development practices (pp.* 97-121). IGI Global.

Zigorous-Coe, I. V. (2013). Promoting collaborative learning in online teacher education. In R. Hartshorne (Ed.), *Teacher education programs and online learning tools: innovations in teacher preparation* (pp. 145-166). IGI Global.

Zigorous-Coe, I. V. (2015). *Teaching discipline-specific literacies in grades 6-12: Preparing students for college, career, and workforce demands*. New York: Routledge. Retrieved on December, 03, 2019, from https://books.google.co.ma/books?hl=fr&lr=&id=w4hBQAAQBAJ&oi=fnd&pg=PP1&dq=Teaching+discipline

APPENDICES

Royaume du Maroc
Université Sidi Mohamed Ben Abdellah
Faculté des Lettres et des Sciences
Humaines Saïs -Fès

المملكة المغربية
جامعة سيدي محمد بن عبد الله
كلية الآداب والعلوم الانسانية سايس – فاس

APPENDIX 1

Doctoral Studies Center: Languages, Heritage and Territorial Management

Doctoral Training: Languages, Literature and Communication

Axis: English Studies

Laboratory: Discourse, Creativity, Society and Religion

Questionnaire for Students

Due to the Information and Computer Technology (ICT) revolution in recent decades, technology enhanced learning tools and formats (e-learning) have become a major component in many educational curricula. A growing number of e-learning tools has been developed and is now used in various settings according to the subject and intention of the educational endeavor.

This questionnaire seeks to gain a better understanding of your experience with the use of e-learning technology in learning engineering. It is designed to collect information on expectations, perceptions and attitudes towards implementing e-learning in Moroccan higher education institutions. Therefore, you are kindly requested to fill in the questionnaire to ease the research on this topic. Note that all the answers provided will be kept strictly confidential and private.

Thank you for your help in furthering this research endeavor

Please put a cross (x) in the appropriate box:

I- Demographic Characteristics

1. Gender: Male ☐ Female ☐
2. Age: (Less than 25) ☐ (26-35) ☐ (36-40) ☐ (Above 40) ☐
3. Name of Your Institution: ENSA ☐ EMSI ☐

4. Level of Education: First Year ☐ Second Year ☐ Third Year ☐

II- Technology Usage

5. Do you possess or have access to a technology device? Yes ☐ No ☐
6. If yes, which of the following devices do you possess or have access to?

   Cellphone/Smartphone ☐ Desktop/laptop computer ☐ Tablet computer ☐

   None of the listed ☐
7. How long have you been using a computer? …………………………
8. How often do you use your computer?

   Never ☐ Seldom-once or twice a month ☐ Occasionally-once a week ☐

   Regularly-twice a week ☐ Often- at least daily ☐
9. Do you have access to the Internet at? :

   Home ☐ College ☐ Other ☐ Specify………………..
10. How much time do you spend surfing the Net per day? ………………………
11. Do you use social media? Yes ☐ No ☐
12. To what degree are you active user in social media?

    Very active ☐ Active ☐ Moderately Active ☐ Not at all Active ☐
13. Do you use synchronous communication tools for learning objectives?

    Yes ☐ No ☐
14. If yes, how many times do you do?

    Rarely ☐ Sometimes ☐ Always ☐
15. Do you use asynchronous communication tools for learning objectives?

    Yes ☐ No ☐
16. If yes, how many times do you do?

    Rarely ☐ Sometimes ☐ Always ☐

III- Digital Skills and Attitudes Towards Educational Technology in Engineering Institutes

17. Are you for or against educational technology?

    For ☐ Against ☐ Neutral ☐
18. Are you comfortable with technology? Yes ☐ No ☐
19. To what degree are you comfortable in using technology?

    Uncomfortable ☐ Somewhat comfortable ☐ Comfortable ☐

    Extremely Comfortable ☐
20. How digitally literate are you?

Novice ☐ Intermediate ☐ Advanced ☐ Expert ☐

21. Do you know what does e-learning education stand for? Yes ☐ No ☐
22. According to you, what are the benefits of adopting e-learning in tertiary education?

…………………………………………………………………………………………

…………………………………………………………………..

23. What are the drawbacks?

…………………………………………………………………………………………

…………………………………………………………………..

24. Does your institution offer an online class? Yes ☐ No ☐
25. Have you ever taken an online class? Yes ☐ No ☐
26. Are you able to use an online platform efficiently? Yes ☐ No ☐
27. Do you need training on e-learning technology? Yes ☐ No ☐

IV- Evaluation of the E-Resources and Facilities in Engineering Institutions

28. Please evaluate the following e-resources and facilities in your institution by checking the appropriate box next to each resource based on the following scale

E= Excellent; G= Good; A= Average; BA= Below average; VL= Very low

RESOURCES TO BE EVALUATED	**E**	**G**	**A**	**BA**	**VL**
The Internet Speed					
The Interactive whiteboard					
The online platforms					
The Laboratory material					
ICT educational material (Projectors, DVD player, PCs, etc.)					
The library Services					
The E-learning Center					

V- Perceptions and Expectations on the Effectiveness of E-Learning in Engineering Education

29. Please rate the following set of statements by checking the appropriate box to each statement based on the following scale:
    SA= Strongly Approve; A= Approve; U= Undecided; D= Disapprove; SD= Strongly Disapprove

STATEMENTS TO RATE	A	SA	U	D	SD
The e-learning system provides information that is easy to use and understand					
Getting information via e-learning systems is better than using printed materials					
E-learning permits more communication with peers and teachers					
E-learning is better than traditional method because it offers maximum engagement of students					
E-learning enhances students' productivity					
E-learning gives more opportunities to the learning process					
I would be interested in studying courses that use e-learning					

I believe that e-learning enhances my learning experience					
E-learning is an easy way to get feedback and notifications from my teachers					

VI- Satisfaction with the Traditional Teaching Paradigm

30. Please rate your general satisfaction level with the different issues related to the conventional teaching paradigm by checking the appropriate box to each item based on the following scale:

HS= Highly Satisfied; S= Satisfied; N= Neutral; D= Dissatisfied; HD= Highly Dissatisfied

ITEMS TO BE EVALUATED	**HS**	**S**	**N**	**D**	**HD**
The way courses are delivered					
Students' involvement in the learning process					
The use of various e-learning tools to impart knowledge					
The adopted instructional strategies fit my needs					
The learning objective are clearly defined					
The tasks and assignments are challenging					
The students are enthusiastic and have real interest in learning					

VII- Evaluation of the Factors Promoting the Adoption of E-learning Technology in Higher Education

31. Please rate the degree of importance of the potential factors that lead to effective implementation of e-learning in higher education institutes. You are required to check the appropriate box to each factor based on the following scale:

AE= Absolutely Essential; HS= Highly Significant; S= Significant; MI= Moderately Important; SI= Slightly Important

FACTORS TO BE EVALUATED	**AE**	**HS**	**S**	**MI**	**SI**
Development of teachers' training					
Development of teachers' training					
Sustained technical assistance					
Adequate ICT infrastructure					
Financial resources					
Lecturers and Learners' attitudes towards educational technology					

Thank you.

Royaume du Maroc
Université Sidi Mohamed Ben Abdellah
Faculté des Lettres et des Sciences
Humaines Saïs -Fès

المملكة المغربية
جامعة سيدي محمد بن عبد الله
كلية الآداب والعلوم الانسانية سايس — فاس

APPENDIX 2

Doctoral Studies Center: Languages, Heritage and Territorial Management

Doctoral Training: Languages, Literature and Communication

Axis: English Studies

Laboratory: Discourse, Creativity, Society and Religion

Questionnaire for Teachers

Due to the Information and Computer Technology (ICT) revolution in recent decades, technology enhanced learning tools and formats (e-learning) have become a major component in many educational curricula. A growing number of e-learning tools has been developed and is now used in various settings according to the subject and intention of the educational endeavor.

This questionnaire seeks to gain a better understanding of your experience with the use of e-learning technology in teaching engineering. It is designed to collect information on expectations, perceptions and attitudes towards implementing e-learning in Moroccan higher education institutions. Therefore, you are kindly requested to fill in the questionnaire to ease the research on this topic. Note that all the answers provided will be kept strictly confidential and private.

Thank you for your help in furthering this research endeavor

Please put a cross (x) in the appropriate box:

I- Demographic Characteristics :

1. Gender: Male ☐ Female ☐
2. Age: (25-35) ☐ (36-45) ☐ (46-55) ☐ (56-65) ☐
3. Place of work: ENSA ☐ EMSI ☐
4. Years of Teaching Experience: (1-10) ☐ (11-20) ☐ (21-above) ☐

II- Technology Usage:

5. Do you possess or have access to a computer? Yes ☐ No ☐
6. If you do, indicate how often you use it:
   Never ☐ Seldom-once or twice a month ☐ Occasionally-once a week ☐
   Regularly-twice a week ☐ Often- at least daily ☐
7. How much time do you spend surfing the Internet per week?
   More than 1 hour a day ☐ More than once a week ☐ Once a week or less ☐
8. Which of the following tech tools do you use for teaching engineering?
   Data projector ☐ Recording materials ☐
   Networked computer ☐ Active Smart Board ☐
9. How often do you use technology in your classroom?
   Rarely ☐ Occasionally ☐ A few times a week ☐ Every day ☐
10. How comfortable are you using different varieties of technology in your classroom?
   Very comfortable ☐ Comfortable ☐ Neutral ☐ Uncomfortable ☐

III- Familiarity and Attitudes towards Educational Technology in Engineering Institutes:

11. Are you familiar with the term “e-learning”? Yes ☐ No ☐
12. Have you ever participated in workshops or seminars that promote the teachers’ ICT skills? Yes ☐ No ☐
13. If you did, please rate the importance of such training in enhancing you digital skills.
   Important ☐ Not important ☐
14. Do you need further training on e-learning technology? Yes ☐ No ☐
15. Are you for or against the integration of e-learning in higher education?
   For ☐ Against ☐ Neutral ☐
16. Does you institution include a course/unit that requires the use of e-learning?
   Yes ☐ No ☐
17. How effective is e-learning compared to traditional classroom-based learning?
   E-learning is effective ☐ Both are the same ☐
   Traditional class-based learning is better ☐
18. What is the degree of students’ awareness towards educational technology?
   Very aware ☐ Somewhat aware ☐ Not very aware ☐ Not at all aware ☐
19. Have you ever tried to help your students be aware of the importance of e-learning technology and comprehend its role? Yes ☐ No ☐
20. Has your institution ever organized an event that aims to raise students’ awareness regarding the importance of e-learning in education? Yes ☐ No ☐

21. According to you, what are the benefits of adopting e-learning in tertiary education?

…………………………………………………………………………………………

…………………………………………………………………..

22. What are the drawbacks?

…………………………………………………………………………………………

…………………………………………………………………..

23. What are the positive impacts of e-learning technology on the students?

- Help them be more independent ☐
- Help them be more active in the classroom as well as outside the classroom ☐
- Help them develop communicative and creative skills and critical thinking ☐

24. Has the Moroccan education system made any initiatives to implement e-learning in higher education? Yes ☐ No ☐

25. If yes, can you provide some examples?

…………………………………………………………………………………………

……………………………………………………………………………..

26. What role does the Moroccan university play towards the implementation of e-learning?

Very active ☐ Active ☐ Moderately active ☐ Inactive ☐

27. What are the factors that impede the successful implementation of e-learning in the Moroccan university?

- Lack of adequate equipment and resources ☐
- Lack of teachers' professional development (seminars/workshops/training) ☐
- Lack of time ☐
- Other/Specify ☐ ……………………………………………………………

28. Do you have any additional comments or suggestions?

…………………………………………………………………………………………

………………………………………………………….

Thank you.

Royaume du Maroc
Université Sidi Mohamed Ben Abdellah
Faculté des Lettres et des Sciences Humaines
Saïs -Fès

المملكة المغربية
جامعة سيدي محمد بن عبد الله
كلية الآداب والعلوم الانسانية سايس –فاس

ANNEXE 2

Centre d'Études Doctorales : Langues, Patrimoine et Aménagement du Territoire

Formation Doctorale : Langues, Littérature et Communication

Axe : Etudes Anglaises

Laboratoire de Recherches : Discours, Créativité, Société et Religion

Questionnaire

Au cours des deux dernières décennies, les technologies de l'information et de la communication (TIC) se sont avérées être de solides outils en termes de processus de développement à travers le monde. Le concept "e-learning" fait désormais partie du vocabulaire lié à l'éducation et est devenus une composante majeure de nombreux programmes d'enseignement.

Ce questionnaire vise à mieux comprendre votre expérience de l'utilisation de la technologie e-learning dans l'enseignement de l'ingénierie. Il est conçu pour recueillir des informations sur les attentes, les perceptions et les attitudes à l'égard de la mise en œuvre de l'e-learning dans les établissements d'enseignement supérieur Marocains. Par conséquent, nous vous demandons de bien vouloir remplir le questionnaire afin de faciliter la recherche sur ce sujet. Notez que toutes les réponses fournies resteront strictement confidentielles et privées.

Un grand merci pour votre précieuse collaboration

Veuillez mettre un (x) dans la case appropriée pour indiquer votre choix :

I- Identification :

1. Etes-vous : Un homme ☐ Une femme ☐
2. Quel âge avez-vous? (25-35) ☐ (36-45) ☐ (46-55) ☐ (56-65) ☐
3. Dans quel établissement enseignez-vous ? : EMSI ☐ ENSA ☐

4. Depuis combien de temps êtes-vous enseignant ?

(1-10) ☐ (11-20) ☐ (21-above) ☐

II- Utilisation des Technologies :

5. Avez-vous un ordinateur à votre domicile ? Oui ☐ Non ☐
6. Combien de temps passez-vous sur votre ordinateur ?
   - Jamais ☐
   - Rarement/une ou deux fois par mois ☐
   - Occasionnellement/une fois par semaine ☐
   - Régulièrement/deux fois par semaine ☐
   - Souvent/au moins une fois par jour ☐
7. Combien de temps passez-vous sur le Net ?
   - Plus qu'une heure par jour ☐
   - Plus qu'une fois par semaine ☐
   - Une fois par semaine ou moins ☐
8. Parmi les outils technologiques suivants, quels sont ceux que vous utilisez pour enseigner ?

   Vidéo projecteur ☐ Matériels d'enregistrement ☐

   Ordinateur avec ou sans Internet ☐ Tableaux interactifs ☐
9. A quelle fréquence utilisez-vous les outils technologiques dans votre class ?

   Rarement ☐ Occasionnellement ☐

   Quelques fois par semaine ☐ Tous les jours ☐
10. Etes-vous à l'aise avec l'utilisation des Technologies de l'Information et de la Communication en classe ?

    Très à l'aise ☐ A l'aise ☐ Neutre ☐ Mal à l'aise ☐

III- Familiarité et Attitudes Envers la Technologie Educative :

11. Etes-vous familier avec le concept «e-learning » ?

    Oui ☐ Non ☐
12. Avez-vous suivi des stages/formations sur un thème en relation avec les TIC ?

    Oui ☐ Non ☐
13. Si oui, indiquer le degré d'importance de ces formations à l'amélioration de vos compétences numériques.

    Important ☐ Pas important ☐
14. Désirez-vous une formation sur les TIC? Oui ☐ Non ☐

15. Etes-vous pour ou contre l’intégration de l’e-learning dans l'enseignement supérieur ?

Pour ☐ Contre ☐

16. Votre établissement comprend-il un cours/unité qui implique l'utilisation de l’e-learning ? Oui ☐ Non ☐

17. Quelle est l'efficacité de l'apprentissage électronique par rapport à l'apprentissage traditionnel en classe ?

E-learning est efficace ☐ les deux sont les mêmes ☐

L’apprentissage traditionnel est mieux ☐

18. Quel est le degré de sensibilisation des étudiants à la technologie éducative ?

Très conscient ☐ Peu conscient ☐ Pas très conscient ☐ Pas du tout conscient ☐

19. Avez-vous déjà essayé d'aider vos élèves à prendre conscience de l'importance de la technologie d'apprentissage électronique et à comprendre son rôle ?

Oui ☐ Non ☐

20. Votre institution a-t-elle déjà organisé un événement visant à sensibiliser les étudiants à l’importance de l’apprentissage électronique dans l’éducation ?

Oui ☐ Non ☐

21. D’après vous, quels sont les avantages de l'adoption de l'e-learning dans l'enseignement supérieur ?

…………………………………………………………………………………………

…………………………………………………………………..

22. Quels sont les inconvénients?

…………………………………………………………………………………………

…………………………………………………………………..

23. Quels sont les impacts positifs de la technologie e-learning sur les étudiants ?

- Aidez-les à être plus indépendants ☐
- Aidez-les à être plus actifs en classe et en dehors de la classe ☐
- Aidez-les à développer des compétences communicatives et créatives et une pensée critique ☐

24. Le système éducatif Marocain a-t-il pris des initiatives pour mettre en œuvre l'apprentissage électronique dans l'enseignement supérieur ?

Oui ☐ Non ☐

25. Si oui, pouvez-vous donner quelques exemples ?

…………………………………………………………………………………………

…………………………………………………………………………..

26. Quel rôle l'université Marocaine joue-t-elle dans la mise en œuvre du e-learning ?

    Très actif ☐ Actif ☐ Modérément actif ☐ Inactif ☐

27. Quels sont les facteurs qui empêchent la mise en œuvre réussie de l'e-learning dans l'université marocaine ?

    - Manque d'équipements et de ressources adéquats ☐
    - Manque de développement professionnel des enseignants (séminaires/ateliers/formation) ☐
    - Manque de temps ☐
    - Autre/Spécifier ☐ ……………………………………………………………

28. Avez-vous d'autres commentaires ou suggestions ?

    ………………………………………………………………………………………

    …………………………………………………….

Merci.

APPENDIX 3

Doctoral Studies Center: Languages, Heritage and Territorial Management

Doctoral Training: Languages, Literature and Communication

Axis: English Studies

Laboratory: Discourse, Creativity, Society and Religion

Interview Guide

Researcher's Name: Kaoutar HANNI

Research' Tittle: The Implementation of E-Learning in Moroccan Higher Education: Engineering Departments as a Case Study

Name of the Interviewee:

Date and Time of the Interview:

Place of the Interview:

The aim of this interview is to help us better understand e-learning in its relationship to the enhancement of Moroccan higher education. It also aspires to clarify the extent to which e-learning technology is manifested in the Moroccan context.

The interview also attempts to highlight the internal and external factors that impede the successful implementation of this new approach in Moroccan higher education institutions, engineering education in particular.

In this regard, this guide has been used to investigate the views of university teachers about this type of learning, namely e-learning. It seeks to, furthermore, explain their own experiences with Information and Communication Technologies, their attitudes and perceptions towards such new modern tools in higher education.

For this reason, you are kindly requested to contribute to the realization of this research through answering the interview questions. Note that all the information provided during this interview will be kept confidential and your answers will be used only for research purposes. Thank you for your help in advance.

- **Personal Information:**

1. Name:
2. Gender:
3. Place of Work:
4. Subject Area:

- **Experience with Information and Communication Technologies:**

5. Would you mind if we talk about your experience of employing modern computer technology in teaching engineering?

- **Benefits of E-learning Integration in Higher Education:**

6. What kind of benefits can professors and students receive from employing e-learning in teaching and learning engineering?

- **Obstacles Influencing Successful Implementation of E-learning in Moroccan Universities:**

7. What are the challenges and obstacles that hinder the successful integration of e-learning in higher education?

- **Guidelines for Successful Implementation of E-learning**

8. Do you suggest additional recommendations or propositions about the practicality of electronic learning in the departments of engineering?

Thank you.

مركز دراسات الدكتوراه: اللغات والتراث والتهيئة المجالية

تكوين الدكتوراه: اللغات والآداب والتواصل

محور: الدراسات الإنجليزية

مختبر: الخطاب، الإبداع ،المجتمع والأديان

دليل المقابلة

اسم الباحثة: كوثر هني

عنوان البحث: تطبيق التعليم الإلكتروني في التعليم العالي المغربي :أقسام الهندسة- دراسة حالة

اسم المبحوث/ة:

تاريخ ووقت المقابلة:

مكان المقابلة:

الهدف من هذه المقابلة هو مساعدتنا على فهم أفضل للتعليم الإلكتروني في علاقته بتعزيز التعليم العالي المغربي. كما أنها تطمح إلى توضيح مدى تجلي تكنولوجيا التعلم الإلكتروني في السياق المغربي. تحاول المقابلة أيضًا تسليط الضوء على العوامل الداخلية والخارجية التي تعرقل التطبيق الناجح لهذا النهج الجديد في مؤسسات التعليم العالي في المغرب، التعليم الهندسي على وجه الخصوص.

في هذا الصدد، تم استخدام هذا الدليل لاستقصاء آراء أساتذة جامعيين حول هذا النوع من التعلم، التعلم الإلكتروني خاصة. علاوة على ذلك، تسعى إلى شرح تجاربهم الخاصة مع تكنولوجيا المعلومات والاتصالات، ومواقفهم وتصوراتهم تجاه هذه الأدوات الحديثة الجديدة في التعليم العالي.

المرجو المساهمة في هذا البحث من خلال الإجابة على أسئلة المقابلة، علما أن جميع ما سيدلى به من معلومات لن يستخدم إلا لأغراض أكاديمية. أشكركم على مساعدتكم.

❖ **بيانات شخصية:**

1. الاسم:

2. الجنس:

3. مقر العمل:

4.المادة التعليمية المدرسة :

- **استخدام تكنولوجيا المعلومات والاتصالات داخل المنظومة التربوية**

5. هل تمانع إذا تحدثنا عن تجربتك في استخدام تكنولوجيا المعلومات والاتصالات في تدريس الهندسة؟

- **أهمية التعليم الإلكتروني في مؤسسات التعليم العالي**

6. ما نوع الفوائد التي يمكن أن يجنيها الأساتذة والطلاب من استخدام التعلم الإلكتروني في تعليم وتعلم الهندسة؟

- **تحديات التعلم الإلكتروني في الجامعات المغربية**

7. ما هي التحديات والصعوبات التي تواجه تطبيق تكنولوجيا التعلم الإلكتروني في مؤسسات التعليم العالي؟

- **مبادئ توجيهية لتحقيق تعلم إلكتروني ناجح**

8. هل تقترح توصيات أو توجيهات إضافية لتطوير التعلم الإلكتروني؟

شكرا لكم.