ADOPTION MODEL FOR SMART LEARNING DEVICES AS E-LEARNING TOOLS IN TVET INSTITUTION: A CASE STUDY OF RVTTI

By

KARONEI ERNEST KIPLANGAT

REG NO: 15/02472

A Research Project Submitted to the faculty of Computing & Information Management in Partial Fulfillment for the Requirements for the Award of the Degree of Master of Science in Management Information System, KCA University

August 2018

DECLARATION

This project is my original work and has not been presented for a degree in any other University. No part of this proposal may be reproduced without the prior written permission of the author and/or KCA University.

Sign: _____ Date: _____

KARONEI ERNEST KIPLANGAT

REG NO: 15/02472

This project has been submitted for examination with our approval as University supervisors.

Sign: _____ Date: _____

Name:

Department:

KCA University

Sign: _____ Date: _____

Name:

Department:

KCA University

DEDICATION

This study is dedicated to my family for their patience and support during my studies.

ACKNOWLEDGEMENT

I would like to acknowledge the following for their support and help regarding with this project. To my ever-loving parents who are always there to give me the courage to pursue my goals and provide financial and emotional support. To my Lectures and mentors who taught me principles that helped me with my study. To my friends who are always capable of giving me enough faith in doing this research at times of failures. And above all, the one who created everything, the one who gives wisdom and strength, the one who picks you up when you feel so broken, to our Almighty Father.

Thank you.

ABSTRACT

Smart learning is the growth of e-learning from the 19th century to 21st-century generations, which enhances the missing component of an e-learning solution. Smart learning most suits for those smartboards, laptops, and smartphones; PDA's and tablets users in TVET education institutes (PILZ, Matthias, 2012). So, exploiting smart devices in educational institutions is mainly measured as enriched tools to facilitate learning. Innovations in smart learning can lead to a changing paradigm in TVET education which smart technologies are believed to have the potential to be used in teaching and learning in technical institutions.

This study discusses and exploits various ways which smart devices can be used as a facilitating tool for e-learning in TVET institutions in Kenya. The study describes the multiple techniques and perceptions of using smart devices to aid in designing and developing e-learning content, approaches to teaching and activity development for learners. Also, this study explore the challenges being faced at the moment and the issues of change management to e-learning in the TVET institutions.

The study uses the survey of experience to identify various factors influencing the use and adoption of smart devices as e-learning tools. Survey of experience, through descriptive statistics is used to develop the adoption model. The evaluation of the model was done using the *k-fold* validation technique. Based on these operations, the study concluded that the intention to use smart devices, and subsequent use is influenced by the Performance Expectancy, Perceived Mobility, Inhibiting Conditions and Facilitating Conditions.

Leveraging the results this study enhances and harmonizes the quality of technical and vocational curriculum in line with current technological needs, while streamlining the current

existing technologies in the delivery of learning in TVET institutions.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

UNESCO - The United Nations Educational, Scientific and Cultural Organization

IICBA - International Institute for Capacity Building in Africa

TVET - Technical and Vocational Education and Training

RVTTI - Rift Valley Technical Training Institute

ICT - Information and Communication Technology

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter is an introduction to the proposed study. It discusses the background to the study, statement of the problem, the purpose of the study, objectives, research questions, significance, and justification of the study, scope and limitations of the study, assumptions of the study, the theoretical framework, conceptual framework, definition of operational terms and summary.

1.2 Background of the Study

E-learning is considered to be sound, practical, and time and cost-saving approach to teach (Gillet et al., 2008). Also, e-learning tools and technologies have been helping students to broaden their knowledge for several decades now (El-Hussein and Cronje, 2010). However, there are still problems in e-learning such as time limitation, low-bandwidth network, fixed location, stickiness of students to their computers, etc. To be able to tackle and solve such problems, scholars now focus on mobile learning. The focus on mobile education has increased after the recent advancements in information and communication technology (ICT), notably mobile technology. With mobile learning, students are not limited to time, fixed location, stickiness to their computers, etc. On the contrary, the education is available anywhere at any time. That is to say; the learning is becoming ubiquitous.

The emergence and advancements of Information and Communication Technologies (ICTs) have changed the way teaching, and learning processes are being conducted. ICTs facilitate immediate access to information resources needed for teaching and learning. According to

Yau et al. (2003), ICTs have capabilities of improving information accessibility; facilitating communication via electronic facilities; enhancing synchronous learning and; increasing cooperation and collaboration. In the teaching and learning process, ICTs are known to be more cost-effectiveness as they facilitate partnerships among learners and tutors and enhance pedagogical improvement through simulations, virtual experiences, and graphic representations.

Information and Communication Technology (ICT) applications enhance the exchange of information between learner-tutor and learner-learner. This takes place through the use of different ICT tools including computers, radio, television, mobile phones and some other devices. These tools provide a suitable platform for the teaching-learning process. Current developments in ICTs have increased the level of interactivity and collaborations among learners and tutors.

Advances in web technology have brought about another opportunity for teaching and learning. Web-based learning platforms are known to limit problems caused by the distance between learners and tutors. Web-based learning is a form of e-learning supported by an internet browser. It occurs through electronic mails, chats, web-based conferencing, message boards and web pages for sharing information resources. It provides a suitable instructional media, facilitates interactive and collaborative learning, and enhances assessment during the teaching-learning process.

Among the ICT tools mostly owned and used by people are the smart devices. These tools can provide suitable learning platforms as they have a lot of applications tutors and learners may use in their academic activities. Learning through such methods is termed as e-learning.

Yong et al. (2011) define mobile learning as electronic learning (e-learning) through mobile computational devices. Smart devices have a potential of improving the teaching and learning processes. Smart technologies are ever-evolving and have changed the world. Many of these changes are highly significant in education. The rise and popularity of smartphones, for example, have paved the way for different tools which are commonly used in the event of incorporating e-learning into the education segment. Universities have witnessed a concomitant surge in the number of students owning at least one or more smart devices. According to a recent report published by the British Broadcasting Corporation (BBC), there are more than 1000 universities that are using iTunes U pages (Apple Computers' institutional repository) (Caballé et al., 2010). The same report notes that there are more than 107,834 educational mobile applications and 700,000 e-books available for Apple devices. Jammes et al. (2005) predict portable campuses and wireless universities to be commonplace by 2017.

As the basis of this research is on the use of smart devices in education, it follows that those capabilities of the tools that apply to school must be identified. The essential features of these devices which are relevant to learners include long battery lives, SIM (Subscriber Identity Module) cards, touch screens, millions of downloadable applications, a vast spectrum of communication possibilities (phone calls, video conferencing, text messaging, social networking and accessing email), as well as a relatively high computing power, to list a few merits (Mtega et al., 2012).

Falloon (2013) posits that the smart devices offer its users complete liberty to decide which apps to download and use, which internet data plan to choose, how to store data (on the Cloud or the device), a choice to retain it secured with personalized device settings, etc. The

almost universal appeal and use of the smart devices coupled with the full range of services it offers makes it a dynamic tool in education (Goerke and Oliver, 2007).

Today teaching and learning techniques have been digitalized thanks to the advancement of technology, which keeps improving day by day (Akemi et al., 2011). This has enabled the growth of education sector in Kenya not forgetting the TVET institutions. One of the developments in the TVET sector is the advent of e-learning methodologies whereby learning is accessed remotely and facilitated through the provision of the internet, networking and email and wireless technologies available within or without the campuses. Advancement in these technologies has enabled the TVET institutions to develop e-learning course materials contents to fit the skilled technique and offer the best practical, creative and adaptive learning through the virtual learning technologies.

This research study will outline various ways in which TVET institution students learn technical skills through smart devices. It will provide preliminary information to the tutors and course designers and students in the TVET institutions on how smart devices can be used as tools for facilitating and learning of technical skills, sharing of data and information, and acquiring of skilled knowledge.

One of the primary missions of Technical Vocational Education and Training authority (TVETA) in Kenya is to increase the supply of skilled human capital to meet labor market demand in Kenya (TVETAUTHORITY, 2016); this is a gap which has been left by the universities. This is due to decrease shortage of skilled resource persons in the industry. The proficient students from the TVET institutions will have the ability for the technical and vocational skills that can be used immediately on the job market and hence becomes a prime choice for the

development of the nation.

To achieve this training and have competent learners ready for the job market, RVTTI procured the smart devices by sourcing funds from the ministry of education, the state department of higher education, the then ministry of higher education science and technology. This enabled the purchase of computers, smart boards, projectors, laptops, fiber connectivity, Wi-Fi technology and installation of a learner management system based on the Moodle e-learning platform. Having all this equipment's on the institute, the board of management decided to provide training to all the lecturers, support staff and technologist on how to use and manage these smart devices to hence capacity training and tools for facilitation to students. The research will make use of the data mining techniques. Fundamentally, data mining is about processing data and identifying patterns and trends in that information so that you can decide or judge. Data mining principles have been around for many years, but, with the advent of big data, it is even more prevalent.

1.3 Problem Statement

One way to achieve mobile learning is the use of smart devices. There are some studies on learning via smart devices that focus only on the technical aspect of the phenomenon. Researchers (Milrad and Spikol, 2007) believe that mobile learning systems and projects and their functional performance (including smart devices) have been extensively studied. However, limited studies are carried out from the end-user's perspective on the acceptance of a learning environment with smart devices. Also, smart devices are being researched in other fields such as healthcare, the delivery service industry, and medical (Peters, 2007). However, it is still not extensively studied in the educational context (Peters, 2007). Therefore, there is

need to explore the perspectives on the use of the devices in educational institutions.

Understanding the factors that influence users' intentions and what leads them to be engaged in using smart devices as e-learning tools are significant, particularly in the dynamic and competitive industry of higher education. The factors are not only considered to be essential to the learning process but also, such understandings help higher education institutions to develop better learning tools and platforms.

Technical skills are the requirements which enable the students to be proactive and build the society, especially those students who didn't get a chance to join the university or college due to grades. This skill can be used in the development of the industrialization and modernization of the Kenyan industries. Rift Valley Technical Training Institute (RVTTI) provides teaching and training of the students through traditional methods of teacher face-to-face meetings in classrooms and lecture halls. With the current trends of technologies available in the institution, learning has been incorporated with the latest technologies already implemented in the institutions. There is currently minimal usage of the smart devices in the institution, hence the need for this study to understand the reasons behind such low consumption. Further, it is essential to gain a better understanding of the critical factors that influence students' acceptance and usage of smart devices as e-learning tools at RVTTI. In an attempt to understand the issue, this study seeks to answer the question: What are the factors that influence the students' intention to use smart devices as their e-learning tools in RVTTI, hence their adoption? It is important to assess the factors influencing the intention to use the devices for e-learning, hence the actual use.

1.4 Objectives of the Study

"The main objective of this study is to establish an appropriate adoption model for smart learning devices in TVET institutions."

1.4.1 Specific Objectives

1. To investigate and identify the factors influencing student's intentions to use smart devices in RVTTI

2. To establish an adoption model that can be used to guide the adoption of intelligent Devices in RVTTI.

3. To evaluate the established model

1.5 Significance of the Study

With the incorporation of smart devices and e-learning modes of teaching and learning in RVTTI, different strategies will be achieved to mainstream and expand to the quality of skilled learning in TVET institutions as a whole. Firstly, it will improve instructional designing and mode of content delivery to students and will facilitate the technical and vocational teaching more effective. Besides, it will enable access to learning and teaching materials from the respective tutors promptly online and on campus. Further, the study enhances and harmonizes the quality of technical and vocational curriculum in line with current technological needs, while streamlining the current existing technologies in the delivery of learning in TVET institutions.

1.6 Motivation

While analyzing the overall effectiveness of using smart devices in education, TVET institutions had been found to avoid their usage owing to their small budgets, while forgetting the tremendous benefits they brought on board in the learning process of students. Because

of the above, the researcher desired to explore smart devices usage while providing a practical model that would allow these institutions to employ them in their learning process as a whole. Through this, the researcher desired to give an overview of the status of the use of smart devices in educational experimental studies, including who was using them, which domain subjects were being taught, what kinds of mobile device and software were being used, where such programs took place, how the devices were used in teaching, and the duration of the interventions.

1.7 Justification

Implementations and explorations of e-learning through the use of smart devices as facilitating tools will enable the institute to grow and reach the global standards. This move would attract students those who were interested in the skilled programs and becoming well acquainted with readiness to work in the industry. Trainers who had the current knowledge and expertise about the technology and industry development would provide the most relevant training to the students and increase the employability of the trainees since accessing of the course content had been made available anywhere at their comfort zones. Also, collaboration with the industry between the institutions would be enhanced through this latest technology whereby the trainees were linked with the sector seamless with a lot of flexible, unlike the traditional attachment placement ways.

With the growth of the institutions regarding the student's population, there were limited facilities and resources to accommodate all the students. To manage and enable the institution to run smoothly, adoption of e-learning through the use of smart devices would ensure that learning continued smoothly without limitation of physical resources.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviews pertinent literature related to the various aspects of the study. Generally, these aspects include the use of smart devices in the education sector, the challenges envisioned and models that will ensure harmony between smart devices and e-learning. Specifically, it provides information on smart learning devices as facilitating tools for e-learning.

2.2 Smart Devices and E-Learning

Smart devices are electronic tools capable of connecting, operating interactively and autonomously, when they are networked through different wireless protocols such as Bluetooth, NFC, Wi-Fi, 3G (Fuster & Scherrer, 2015). The term may primarily refer to numerous different types of electronic equipment, ranging from those that are principally operated by individuals, for instance, smartphones, to the constitutive elements of so-called 'ubiquitous computing,' that is, a setting with pervasive sensors and information-processing capability. In

this context, Smart devices include; smartphones, Personal Digital Assistants (PDAs) and other portable, handheld and palmtop personal computers (Traxler, 2009).

Smart devices have gradually been introduced into educational contexts over the past two decades. This technology has led to most people to carry their individual small computers that contain exceptional computing power, such as laptops, personal digital assistants (PDAs), tablet personal computers (PCs), cell phones, and e-book readers. This massive amount of computing power and portability, combined with the wireless communication and context sensitivity tools, makes one-to-one computing a learning tool of great potential in both traditional classrooms and informal outdoor learning.

Concerning access to computers, large-scale one-to-one computing programs have been implemented in many countries globally (Peters, 2007), such that elementary and middle-school students and their teachers have their own mobile devices. Concerning promoting innovation in education via information technology, not only does mobile computing support traditional lecture-style teaching, but through convenient information gathering and sharing it can also develop innovative teaching methods such as cooperative learning, exploratory learning outside the classroom, and game-based learning. Therefore, mobile technologies have great potential for facilitating more innovative educational techniques. Simultaneously, these patterns in instructional methods will likely not only help subject content learning, but may also promote the development of communication, problem-solving, creativity, and other high-level skills among students.

However, despite the proposed advantages of using smart devices for increasing computer accessibility, diverse teaching styles, and academic performance, currently researchers found

mixed results regarding the effects of mobile-devices, and very few studies have addressed how best to use mobile devices and the effectiveness of doing so.

Shabtai et al. (2012) believed that school programs integrating smart devices into schools have a positive impact on student learning. However, they also thought that the devices use did not achieve the goals of increasing higher-level thinking and transformation of classroom teaching methods.

The cultural dimension of learning is new in this globalization era. This is because, there is a culture where the learning process has begun and the technology associated with multimedia or multi-cultural teaching (Dara tafazoli et al., 2016). Therefore, it is a hope for a learning culture must be viewed holistically to develop a more appropriate method. The definition of culture here refers to the cross-culture theory where cultural dimensions have been implemented in studying human behavior. The culture of learning has been changing from time to time in line with global technological developments. This culture begins with learning using the textbook. Then, it turned to the computer-aided learning, and when the technology grows, the use of internet in teaching and learning are more widespread (Anderson & Terry, 2008).

The Internet can be applied in education through activities either in their daily work, or that involves teaching and learning process. There are signs of construction the new technology to increase learning performance. The Internet revolution is not only to search for global information but even build and strengthen the ties between human beings to communicate. Electronic mail (e-mail) is one of the internet services that are widely used. Besides, Usenet and Internet Chat is a service that allows people to communicate with anyone using a computer. Therefore, teachers and students can join discussion groups to ask questions,

discuss questions and share experiences and knowledge online (Shaozi et al., 2013).

Currently, information is available on the website in the form of a database, documents, government information, online bibliographies, publications and computer software. Most of the information provided is updated and available for free and quickly accessible by anyone. Teachers and students can publish materials on the internet. The process of publication through the internet is faster and cheaper than the traditional channels. The work of teachers and students can be sent to the internet so the world can read them or make an assessment of a lesson developed.

The internet has enabled the service and training programmers delivered via online and remotely accessible. E-learning or online learning is learning through the implementation of technology support services such as telephone, audio, video, satellite transmission or computer. However, smart education has been used to support e-learning. In recent years, the quick growth of the use of ICT technologies promises a new revolution that might be comparable with the Web. In brief, one of the significant advantages for smart learning is where learning previously occurred in front of a computer terminal, in the classroom, laboratory or at home, it has now enabled to happen in the field, or at any location where the smart device is fully functional. Smart Learning can be defined as the ability to perform training and assessment tasks using any device connected to any network. At present, smart learning is defined as the technology in education. This is different from traditional teacher-based face-to-face classroom learning, where the learners can seat in a classroom and listen to the lectures as opposed to smart knowledge where learning, information, and resource sharing is not confined in one location. (Vladimir et al., 2015). Smart learning is a learning that

carried out through intelligent devices which are informed of laptops, smart boards, projectors, online, mobile phones and many researchers provide a complicated definition of smart learning.

Smart learning also gives the students a head start in the IT revolution, equipping them with skills not only to do well in their studies but also to excel in their future careers. It allows students to use their laptop computer for their studies on campus, thereby making student learning mobile.

2.3 Empirical Studies

In a study to explore the users' acceptance and behavioral intention to use smart devices in Sweden, Aziz (2015) outlines various factors affecting users' intention to use smart devices. He uses Technology Acceptance Model (TAM), Unified Theory of Acceptance and Usage Technology model (UTAUT) and Expectation-Confirmation Theory (ECT) in his analysis. Based on the constructs of these models, he carries out hypothesis testing. Aziz in his study concludes that 'Performance Expectancy, Perceived Mobility value, Confirmation, and Satisfaction positively influence both Behavioral and Continuance Intentions of students to accept and continue using smart devices as u-learning tools' (Aziz, 2015)

2.3.1 Technology Acceptance Model (TAM)

This model was formulated in 1986, to be used in the context of information technology and education to describe and explain the intentions of students to adopt and use information systems. The framework helps to interpret the relationship between the Perceived ease of use and the Perceived ease of usefulness. The model also helps to describe the relationship between perceived usefulness and the user's attitudes and intentions concerning

technological advances. According to this model, Perceived usefulness refers to how the technology helps the user to achieve a particular task. On the other hand, perceived ease of use refers to the extent to which the user finds it easy to use the technology. According to this model, the use of technology by an individual is influenced by their behavioral intentions, perceived ease of use and perceived usefulness. In the context of this study, the plan to use smart devices by RVTTI students depends on the factors pointed out.

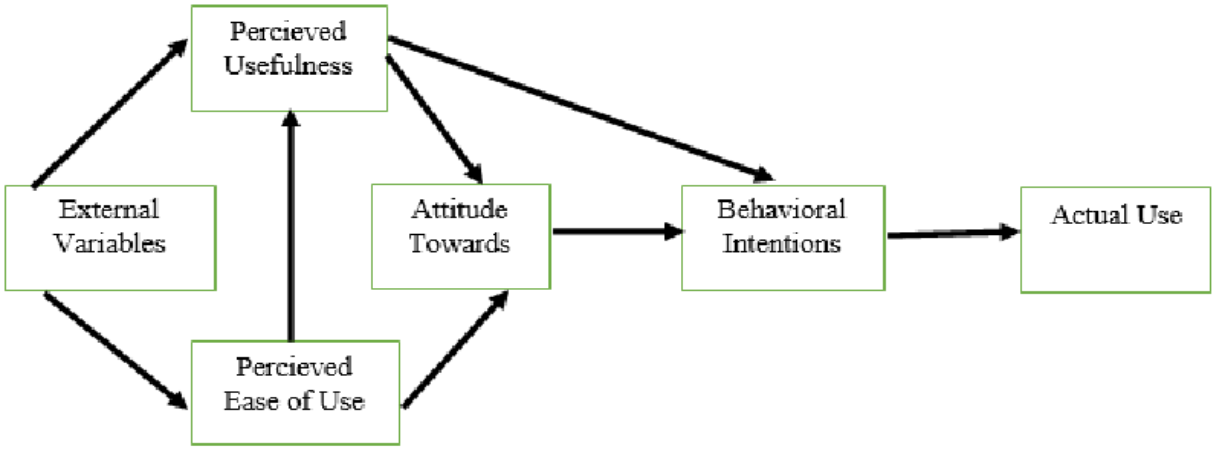


Figure 2.1 Technology Acceptance Model (TAM)

2.3.2 Unified Theory of Acceptance and Usage Technology model (UTAUT)

This model is a modification of the TAM framework to predict the acceptance of technology based on technological advancement. It was introduced by Venkatesh et al. (2003). It is based on two essential elements. These determinants are behavioral intentions and facilitating conditions. Behavioral plans are directly dependent on social influence, performance and effort expectancy. On the other hand, promoting functions implies the available resources required by the user to use the technology. This model also makes use of other variables such as the age, gender, age, familiarity and voluntariness of using the technology. This model

is relevant to this study as it investigates the intentions affecting adoption of new technology. In this case, it helps to outline the factors that influence the plan to use smart devices by RVTTI Students.

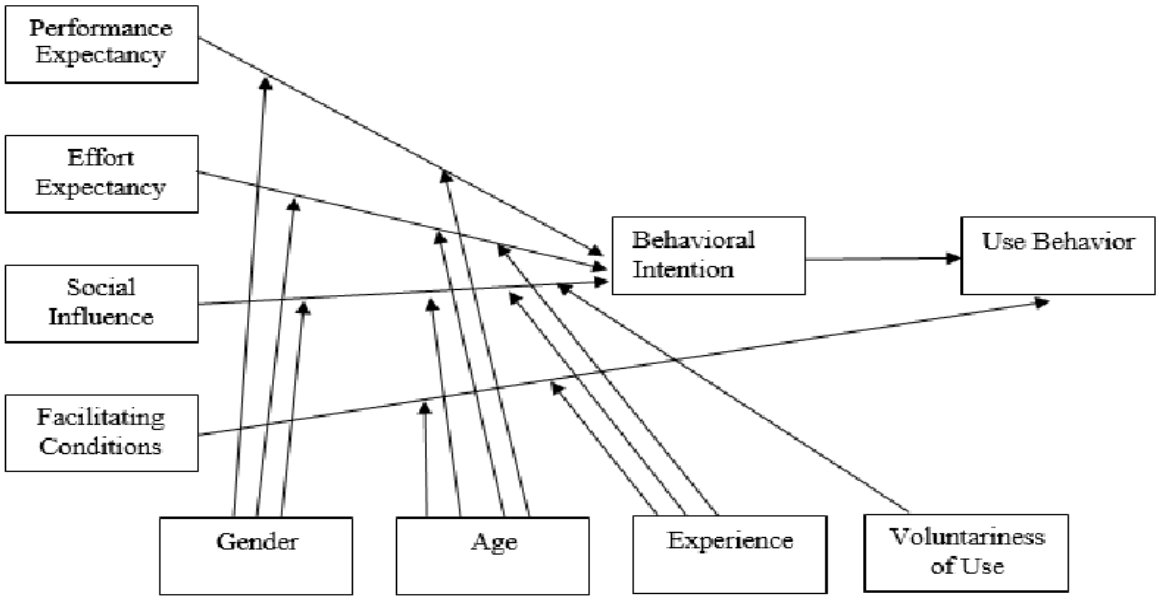


Figure 2.2 The Unified Theory of Acceptance and Usage Technology model

This model was later modified to incorporate hedonic motivation, habit, and price as factors affecting the user's intention to use the new technology. The new model would be referred to as UTAUT 2. Like the previous model, this framework uses age, gender, and experience to arbitrate the existent constructs.

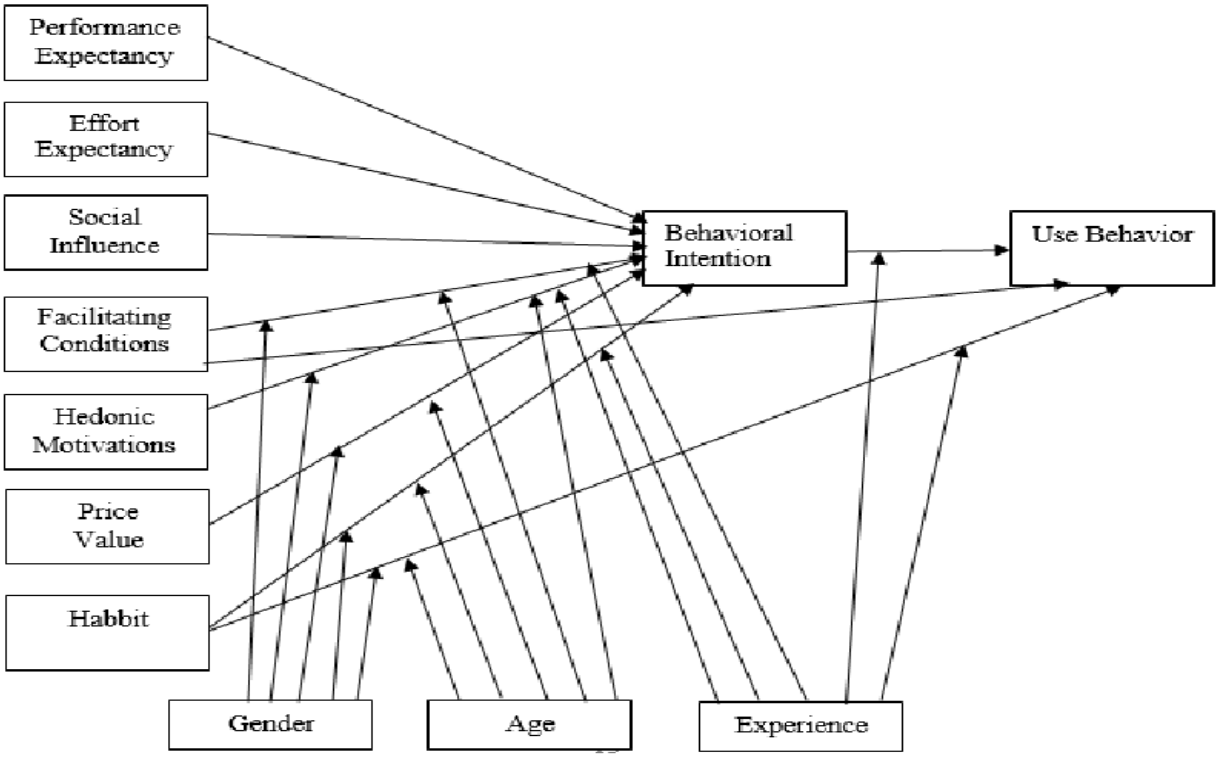


Figure 2.3 The Unified Theory of Acceptance and Usage Technology model 2

2.3.3 Expectation-Confirmation Theory

Both UTAUT and UTAUT2 clearly outline the factors influencing the acceptance of the smart devices. However, they still cannot determine whether the user can continue using the new technology in the post-acceptance stage. ECT model is therefore developed to explain the behavior of the user in the post-acceptance stage. According to the ECT model, a user forms an expectation before buying or using any product. After using the service, he creates a perception regarding its performance. Thirdly the user assesses the performance of the product concerning his expectation. This is referred to as confirmation. Based on confirmation results, satisfaction and continuance intentions are determined. As such, satisfied customers continue using the technology products or services.

ECT model is applied in this study to the extent that, factors influencing the students' intention to use smart devices are being investigated.

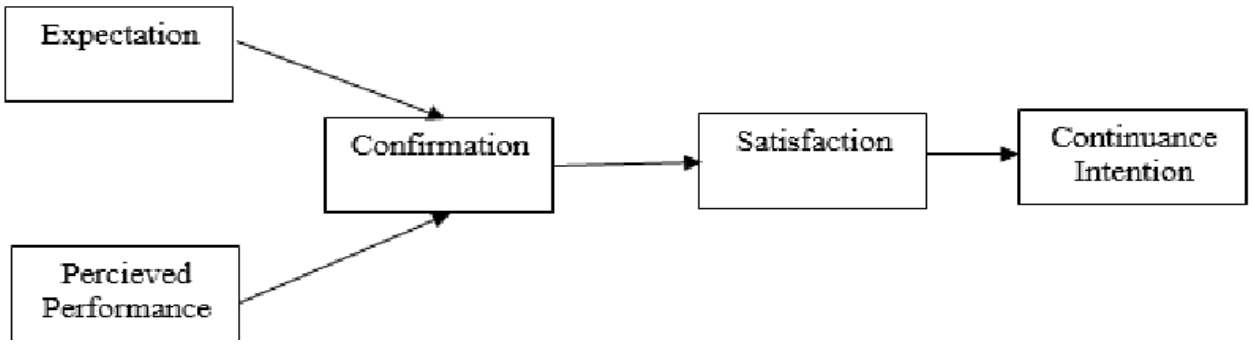


Figure 2.4 Expectation-Confirmation Theory

Regarding the review of online-based programs, Zucker and Light (2009) believed that school programs integrating online programs into schools have a positive impact on student learning. However, they also felt that smart devices use did not achieve the goals of increasing higher-level thinking and transformation of classroom teaching methods. Penuel (2006) reviewed 30 studies that examined the usage of smart devices with wireless connectivity in one-to-one computer programs. Those studies found that students most often used the tools to do homework, take notes, and finish assignments. General-purpose software such as word processors, web browsers, and presentation software was relatively standard. Bebell and O'Dwyer (2010) examined four different empirical studies of smart devices in schools. They discovered that in most schools participating in one-to-one programs there were significant increases in grade-point averages or standardized tests of student achievement, relative to schools that did not provide such programs. Also, they found that most students used their devices to write, browse the Internet, make presentations, do homework, or take tests. Furthermore, teachers made more changes to their teaching methods when they had

increased opportunities to use laptops. Students participating in one-to-one programs also had a deeper engagement with what they were learning when compared to control groups.

Fleischer (2012) conducted a narrative research review of 18 different empirical studies on the usage of smartphones. These studies found an extensive range in the number of hours that students used smartphones, from a few days to as little as 1h per week. The most frequently used computer functions were searches, followed by expression and communication. In most studies, it was found that students had a positive attitude toward smartphones and felt that they were more motivated and engaged in their learning, and it was further believed that teachers conducted more student-centered learning activities. Moreover, considerable differences in classroom educational practices arose from the diversity of teachers' beliefs about the usefulness of smartphones. Fleischer (2012) also found several challenges regarding the use of smart devices in classrooms, such as encouraging teachers to change their previous beliefs and teaching methods (e.g., teacher-centered lectures) in response to their students' greater flexibility and autonomy; how to reconcile the conflict between the students' desire for independent study and the need for teachers' guidance; and how to facilitate teachers' competence by designing an appropriate curriculum and teaching models for laptop usage programs.

Concerning the research on the use of mobile technology in education, Hwang and Tsai (2011) provided a broad discussion of studies on mobile and ubiquitous learning published in six journals between 2001 and 2010. In their review of 154 articles, they discovered that the use of mobile and ubiquitous learning accelerated markedly during 2008; researchers mostly studied students of higher education, and the fields most often researched were language arts,

engineering, and computer technology. Frohberg, Goth, and Schwabe (2009) categorized 102 mobile-learning projects and discovered that most mobile-learning activities occurred across different settings and took place within a physical context and a proper environment, such as a classroom or workplace. Regarding the pedagogical roles that mobile devices play in education, most research has used mobile devices primarily as a sort of reinforcement tool to stimulate motivation and strengthen engagement, and secondarily as a content-delivery tool. Few projects have used mobile devices to assist with constructive thinking or reflection. Furthermore, most learning activities using mobile devices have been controlled by the teacher, with there being only a handful of learner-centered projects in existence. Concerning the communication functions, very few projects have made any use of cooperative or team communication. Moreover, the vast majority of studies have made use of novice participants; little research has involved experienced participants. When sorted according to educational goals, it was found that the vast majority of research has focused on lower-level knowledge and skills and ignored higher-level tasks such as analysis and evaluation. Wong and Looi (2011) investigated the influence of mobile devices on seamless learning. Seamless learning refers to a learning model that students can learn whenever they want to learn in a variety of scenarios and that they can switch from one situation or one context to another quickly and quickly (Wong and Looi, 2011). Wong and Looi (2011) selected and analyzed a sample of 54 articles on the use of mobile devices to facilitate seamless learning, and found that all 54 items contained ten features, including formal and informal education, personalized and social learning, and learning across multiple durations and locations.

2.4 Conceptual Framework

This study sought to identify the factors that influenced the intentions of RVTTI students to

use smart devices as e-learning tools. The variables in this study were Intention to use Smart devices, Performance Expectancy of Students, Perceived Mobility value and Facilitation Conditions.

2.4.1 Description of Variables

Individual Attributes

Some of the personal attributes in this study included the age, sex, and experience. The tendency to adopt technology varies across the genders. The range in the age of students in technical institutions was insignificant and would strongly affect their behavioral intention to use Smart Devices. This study would investigate these attributes concerning students' plans to use the devices.

Intention to use Smart Devices as learning tools

This variable could also be termed as behavioral intention (BI). It refers to the perceived likelihood of an individual to perform a particular action. This was the independent variable in the Technology Acceptance Model (TAM). This research sought to investigate this variable concerning the use of Smart devices as e-learning tools by RVTTI students. It is the dependent variable in the study.

Perceived Mobility Value

Users of a technology appreciate it based on how they understand it to be mobile. If the technology can be quickly moved from one place to another, the users will regard it as having a high mobility value. This variable is derived from the Technology Acceptance Model (TAM). According to this model, Perceived Mobility value positively affects the Behavioral Intention to

use the technology. This research, therefore, seeks to investigate this variable as a factor influencing behavioral intention to use Smart Devices as e-learning tools in RVTTI.

Facilitating Conditions

Facilitating conditions are enablers or barriers which influence an individual's perception of ease or difficulty to perform a particular task. In the context of the UTAUT Model, facilitating conditions comprise of necessary resources and knowledge, in addition to the compatibility of smart devices to e-learning content. In the model, promoting conditions positively affect behavioral decision to use technology. This study seeks to investigate this variable as a factor influencing behavioral intention of students in TIVET institutions to use smart devices in e-learning.

Performance Expectancy

Performance expectancy refers to the belief that a specific technology will enhance the performance of an individual. This is one of the variables in the UTAUT Model. In the context of this study, it refers to how smart devices will improve the grades and save time for students in RVTTI. This study, therefore, investigates how this variable affects the students' behavioral intentions to adopt and use Smart devices in their learning.

Inhibiting conditions

Inhibiting conditions are factors which suppress an individual from carrying out a particular task. In this context, the study seeks to explore various factors which hold back students from using smart devices as e-learning tools. An example of inhibiting factors is the cost of acquiring the intelligent devices.

Variables	Sub Variables	Indicators	Values
Individual Attributes	Age	Age Bracket	Less than 18 Years 18-24 Years 25-28 Years More than 28 Years
	Gender	Gender Value	Male/Female
	Experience	Duration of Usage	Number of months
Intention to use Smart Devices as learning tools	Intention	Value of intention	Likert Scale (1-5)
Perceived Mobility Value	Degree of Mobility	Strength of mobility of Smart devices	Likert Scale (1-5)
	Ubiquitous learning	Value of Ubiquitousness	Likert Scale (1-5)
Facilitating Conditions	Resources allocated	Value of resource availability	Likert Scale (1-5)
	Knowledge	Value of Knowledge	Likert Scale (1-5)
	Compatibility	Value of compatibility	Likert Scale (1-5)
Performance Expectancy	Knowledge Acquired	Value of Knowledge Acquired	Likert Scale (1-5)
	Student's Expectations	Level of met expectation	Likert Scale (1-5)
	Time Saved	Strength of Time Saved	Likert Scale (1-5)
	Academic Performance	Strength of Academic performance	Likert Scale (1-5)
Inhibiting conditions	Cost of Smart Devices	Strength of costliness	Likert Scale (1-5)
	Requisite knowledge	Value of requisite Knowledge	Likert Scale (1-5)

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology that was employed in carrying out the study.

3.2 Study Area

Rift Valley Technical Training Institute (RVTTI) is a public technical training institute located in the highland city of Eldoret, Kenya. It is one of the Technical Training Institutes in Kenya. The institution offers Artisan, Craft, Diploma and Higher Diploma Courses with a bias to practical industrial applications.

The institution started in 1962 as a technical and trade school. In 1979, it was given high school status and began A-level courses in mathematics, physics, and chemistry. In 1986, the school was elevated further to become the regions first technical training institute. The Institution has continuously grown, and in recognition to this sustained prosperity, it was nominated in 2013 to be an "East African Community Center of excellence." In TVET In 2016, the institution became a UNESCO-UNEVOC network center, the only TVET institution to have such recognition in East and Central Africa.

3.3 Research Design

Quantitative data focused on numeric and statistical data to investigate, interpret, and

structure the findings. Based on earlier research on TAM, UTAUT, and ECT in the context of higher education, two hypotheses were tested. A quantitative methodology was chosen, to accomplish the objective of this study and a survey plan based on purposive and convenience sampling techniques were used. A web-based inquiry form on five-point Likert Scale was designed to gather the requisite data. Besides, the purpose of the study was to find the key factors that influence students' behavioral intention towards using smart devices as e-learning tools, not about formulating a theory. Thus, the deductive approach was selected for the study. A survey was conducted on the students to find out the students' behavioral intention towards the usage of smart devices as e-learning tools.

3.4 Data Collection

3.4.1 Secondary Data

Documentation Review method was used to survey the secondary data. The data was used to achieve objective 1 and 2. Google Scholar and other search engines were the main means to gather valuable literature resources and information to conduct this study scientifically. The search engines that were used include databases such as JSTOR, Diva, Web of Science, etc. Besides, the advanced search option of the Library's search engine was user-friendly and easy to find the required article, journal or book. In fact, Google Scholar was more helpful in finding the necessary reading materials for this study. The information was retrieved by inputting relevant keywords into the search engines.

3.4.2 Primary Data

Questionnaires, interviews and observation methods were used to achieve objective three. These methods constituted primary data sources for research projects. The primary data for

this study was gathered through survey questionnaire from RVTTI students. The primary data collected was processed, assessed and analyzed to test the hypotheses.

3.4.3 Data Collection Methods

The data collection methods depended on the type of the data needed for research. For qualitative data usually, interviews were preferred. For quantitative data such as this study the questionnaire through a survey was favored. Quantitative data was also achieved from observations and document studies. A suitable method for a survey strategy like this one was a questionnaire.

3.5 Population and Sample

Population refers to all the items in the category of things that are being researched. With other words, it means a study population that a researcher is interested in to generalize a theory, assumption, hypothesis, etc. A sample refers to a small sub-group that is chosen for a study. With other words, a sample is a subset of a population that represents the population in research. The sampling units are the individual members of the sample that contribute to the study

The sampling for the experience survey used non-probability sampling technique. Randomization would not obtain a representative sample. As such the non-probability design was appropriate. In particular, both purposive and convenience sampling were applied. Convenience sampling were relevant since students were selected based on their availability. Furthermore, purposive sampling was used since the survey sought only members of a particular group. In this case, the sampling units were the students of RVTTI. According to Denscombe (2010), for a population of 5000 items/individuals and over, a representative

(probability) sample size of 430 respondents from the population was adequate to represent the population. However, for non-probability sampling techniques and exploratory sample, Denscombe (2010) recommends a sample size between 30 to 250 respondents. In fact, to be able to conduct a reliable and valid test, the researcher expected to collect 430 responses. Purposive and convenience sampling was therefore used to achieve the third objective.

3.6 Data Analysis

After obtaining the relevant data from the field as well as secondary documented literature, we subjected it to content analysis. This method helped to convert qualitative data into a quantitative format for further investigation. The research achieved this through reading and coding. Both summative and conventional approaches were used to meet objective one and two. After the completion of the survey, the collected data was imported into Excel and modified for further use. For this research, mostly ordinal and nominal values were considered. Statistical operations such as Pearson's coefficient correlation, regression analysis, chi-square,

Cronbach's alpha and SEM will be conducted to analyze the data. SPSS 22 and SPSS Amos,

Statistical Packages for the Social Sciences, developed by International Business Machine (IBM) were the tools to analyze the collected data. Besides, these tools provided basic statistical operations such as finding the mode, median, percentile, etc. The data for this study was presented in the forms charts, diagrams and graphs.

3.7 Ethical Considerations

To avoid ethical problems during the investigation, an informed consent form with electrical signing possibility was sought. It was necessary to avert privacy, social and physical risks to the participants in the survey. Voluntary participation was stressed in the consent form.

Moreover, personal or private information such as names, addresses, email accounts, etc. were avoided in the questionnaire. Thus, the poll was entirely anonymous to ensure confidentiality. The participants were given the option to be able to stop the survey at anytime and anywhere in the review. Such concerns were clearly stated in the consent form. Although, one of the conditions to participate in the survey was the respondent to be 18 years old, there was no way to find out if any under 18 years were able to participate in the survey questionnaire.

Table: Research methodology Summary

Research method (techniques)	Research objectives
Survey experience through descriptive analysis	Objective one: *To investigate and identify the factors influencing student's intentions to use smart devices in RVTTI*
Survey experience through descriptive analysis (Correlation Matrix)	Objective two: *To establish an adoption model that can be used to guide the adoption of smart Devices in RVTTI.*
Percentage split and *k-fold cross validation* techniques	Objective Three: *To evaluate the established model*

3.8 Pilot Study

Before conducting the actual study, a pilot study was done to evaluate the established adoption model. The pilot study entailed a survey conducted on 15 Technical University of

Kenya students. The institution best exemplified the characteristics of RVTTI as a TIVET institution. Through random sampling, fifteen students were selected for the study. They were issued with standardized questionnaires containing the relevant questions for the survey. The Cronbach Alpha value for the data was found to be 0.965366646 showing that the evidence was consistent and reliable to reflect the actual study results. The data collected from the fifteen questionnaires were subjected to statistical analysis to get the summary statistics and correlation values of different variables. The results indicated that the Perceived mobility influenced the intention of students to use smart devices as their e-learning tools, Performance expectancy, Facilitating conditions and inhibiting conditions. Based on the results of the survey, the pilot study concluded that the conceptual framework had adequately captured the reality of using Technology in the learning institution. However, the limitation of having a small sample made it necessary to conduct the real study.

CHAPTER FOUR

DATA ANALYSIS AND RESEARCH FINDINGS

4.1 Results for objective One

The first objective of this research was to investigate and identify the factors influencing student's intentions to use smart devices in RVTTI. As such a survey of experienced was used, where Primary methods of data collection were employed to investigate the existence of the factors and their relationship. A questionnaire was designed with questions covering the six variables under investigation. Since the data was primarily qualitative, descriptive measures were used. As such, the respondents would answer the questions by checking on any of the five options below each item. These options were Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. The detailed responses were rated on a scale of 1 to 5, with one representing Strongly Disagree while 5 representing Strongly Agree. For the study, 430 questionnaires were issued to the RVTTI Students. As previously suggested, purposive sampling technique was used to come up with the sample. The research used statistical mode to find out which value occurred most.

To obtain the consistency and validity of the data collected, the study subjected the results to statistical analysis, to find the Cronbach Alpha Value. Using the Excel statistical package,

we obtained the table below. We then generated the value using the formula

$$\text{Cronbach Alpha Value} = 1 - (\text{Standard Mean Error} \div \text{Column Error})$$

Furthermore, the study used testing methods of regression and correlation to assess the relationship between the variables.

Anova: Two-Factor Without Replication						
SUMMARY	*Count*	*Sum*	*Average*	*Variance*		
Row 1	12	1079	89.91667	5728.083		
Row 2	12	2280	190	5143.455		
Row 3	12	844	70.33333	3361.333		
Row 4	12	445	37.08333	6948.447		
Row 5	12	80	6.666667	268.6061		
Column 1	5	394	78.8	13820.7		
Column 2	5	394	78.8	9673.2		
Column 3	5	394	78.8	9620.7		
Column 4	5	394	78.8	5863.7		
Column 5	5	394	78.8	8593.7		
Column 6	5	394	78.8	7595.2		
Column 7	5	394	78.8	9361.7		
Column 8	5	394	78.8	6099.7		
Column 9	5	394	78.8	9673.2		
Column 10	5	394	78.8	18604.7		
Column 11	5	394	78.8	4447.7		
Column 12	5	394	78.8	14145.7		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-*	*F crit*

					value	
Rows	234050.4	4	58512.61	10.91148	3.11E-06	2.583667
Columns	2.33E-10	11	2.12E-11	3.95E-15	1	2.014046
Error	235949.2	44	5362.481			
Total	469999.6	59				

Anova: Two-Factor without Replication

Using the values obtained in the ANOVA table,

Cronbach Alpha Value=1-(5362.481÷58512.61)

The Cronbach's Alpha for the results obtained in the pilot study was 0.908353409. This value indicated that the internal consistency was excellent

The results of the survey were presented according to each category under investigation. The primary areas are as follows:

18-24 years	25-28 Years	29-34 years	Total
264	79	51	394
67%	27%	7%	100%

Individual Attributes

Under this category, the study sought to investigate the gender and age of the respondents. The results from the fifteen respondents are tabulated below:

Male	Female	Total

209	185	394
53%	47%	100%

The experience of students in using Smart devices as e-learning tools were captured in the study and presented in the table below:

Table 4.3 Experience of respondents in using Smart Devices as e-learning tools

Less than 6 Months	6-12 Months	13-18 Months	More than 18	Total
51	130	158	55	15
13%	33%	40%	14%	100%

The results obtained indicated that the age of students was a critical factor influencing the intention of students to use Smart devices in learning. Notably, the highest number of students using the gadgets were in the age bracket of 18-24 years. Gender did little to determine the use of the devices. Regarding the experience, it was noted that between zero to eighteen months of use, the use of the devices increased with the level of expertise. As such, individual attributes were essential determinants of students' intention to use smart devices as e-learning tools.

Table 4.4 Response of students on the other 12 Questions

	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %	Total
Question 6	66%	34%	0%	0%	0%	100%

Question 7	40%	53%	7%	0%	0%	100%
Question 8	27%	60%	13%	0%	0%	100%
Question 9	7%	47%	33%	13%	0%	100%
Question 10	13%	60%	20%	7%	0%	100%
Question 11	13%	46%	41%	0%	0%	100%
Question 12	20%	60%	20%	0%	0%	100%
Question 13	27%	46%	27%	0%	0%	100%
Question 14	40%	53%	7%	0%	0%	100%
Question 15	20%	80%	0%	0%	0%	100%
Question 16	0%	33%	40%	20%	7%	100%
Question 17	0%	7%	7%	73%	13%	100%

Intention to use smart devices as e-learning tools

To investigate this variable, the respondents were asked whether they intended to use Smart devices as e-learning tools. The responses, as captured in the chart below indicated that 100% of them generally, agreed to the question. Notably, 67% strongly agreed while 33% agreed.

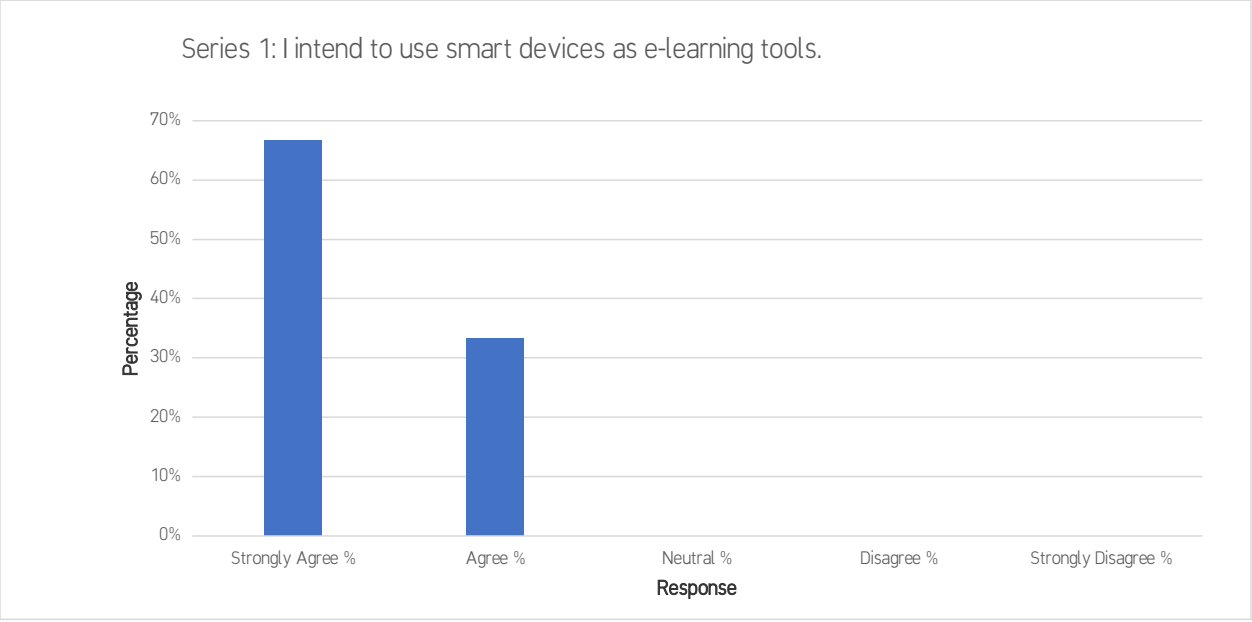


Figure 4.1 Graph showing Intention of respondents to use smart devices as e-learning tools

Perceived mobility value

The study investigated this factor by asking the students whether the devices allowed them to accomplish their tasks any place any time. The results indicated that 93% of the students agreed to this question. Secondly, they were asked if the devices could be moved from one place to another. They overwhelmingly agreed to this question with 87% response to the affirmative. Based on these results, the study inferred that perceived mobility value was an essential determinant of students' intention to use smart devices as e-learning tools.

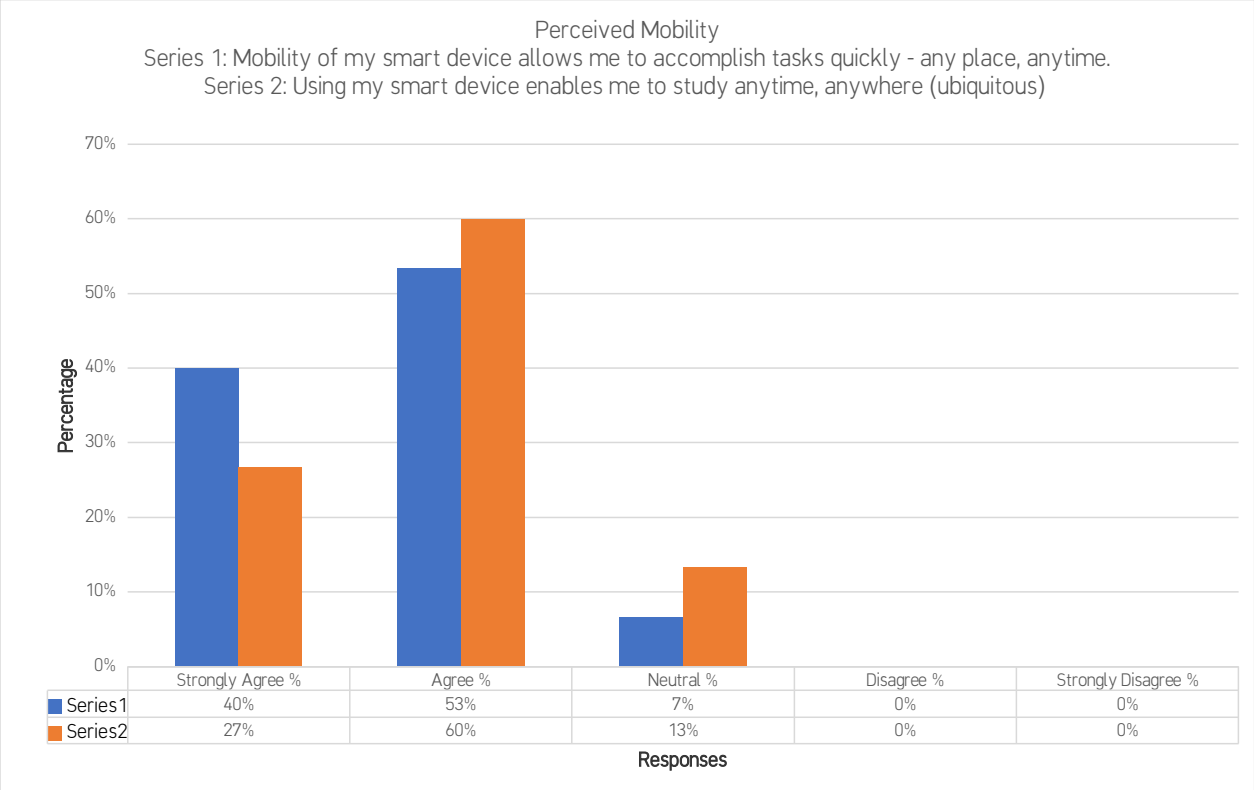


Figure 4.2 Chart showing the response of students regarding the perceived mobility of Smart devices

Facilitating conditions

As pointed out previously, promoting conditions comprise of factors such as resources, knowledge, and compatibility of smart devices with e-learning content. To investigate the variable, the questions were posed capturing the three elements, as shown in the chart. 74% of the respondents indicated that they had sufficient knowledge to use the devices. 26 % of the respondents were neutral as to whether they had the requisite knowledge to use the tools. Regarding the resources, 80% of the students indicated that they had sufficient funds to facilitate their use of the smart devices. The remaining 20% were neutral as to the availability of the resources. Additionally, 93% of the respondents affirmed that the smart devices were compatible with the e-learning content. The remaining 7% were neutral. As such, the study resolved that facilitating conditions were essential determinants of the students' intention to use the smart devices as e-learning tools.

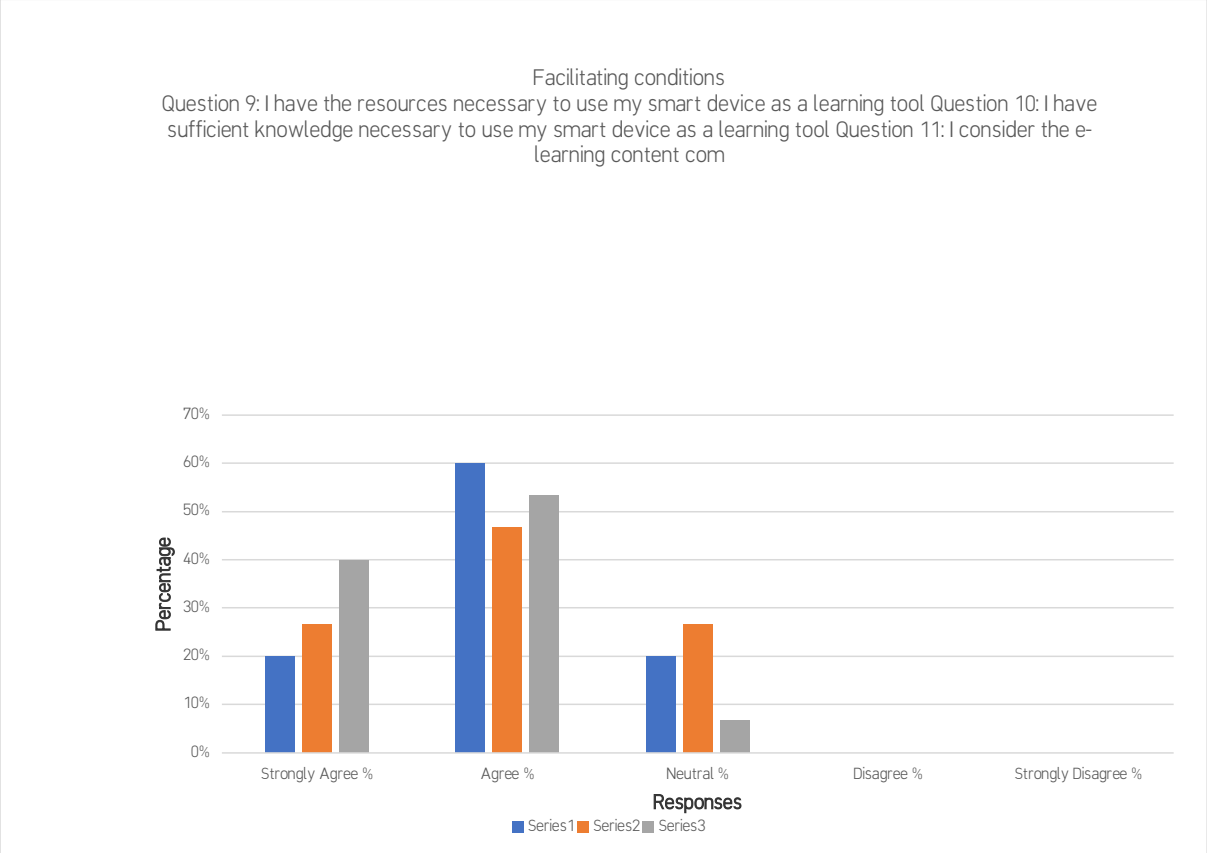


Figure 4.3 Chart showing the response of students to the questions of facilitating conditions

Performance expectancy

The study investigated this factor using sub-variables such as knowledge, students' expectations, time saved and academic performance. The four questions indicated in the chart were posed to the fifteen respondents. 80% of the respondents agreed that smart devices had improved their level of knowledge. 74% observed that the tools had matched their expectations in supporting e-learning. The remaining 26% were neutral. 93% of the respondents noted that the devices had significantly helped them save their time in learning. Furthermore, 100% of the students indicated that the tools helped them improve their academic performance.

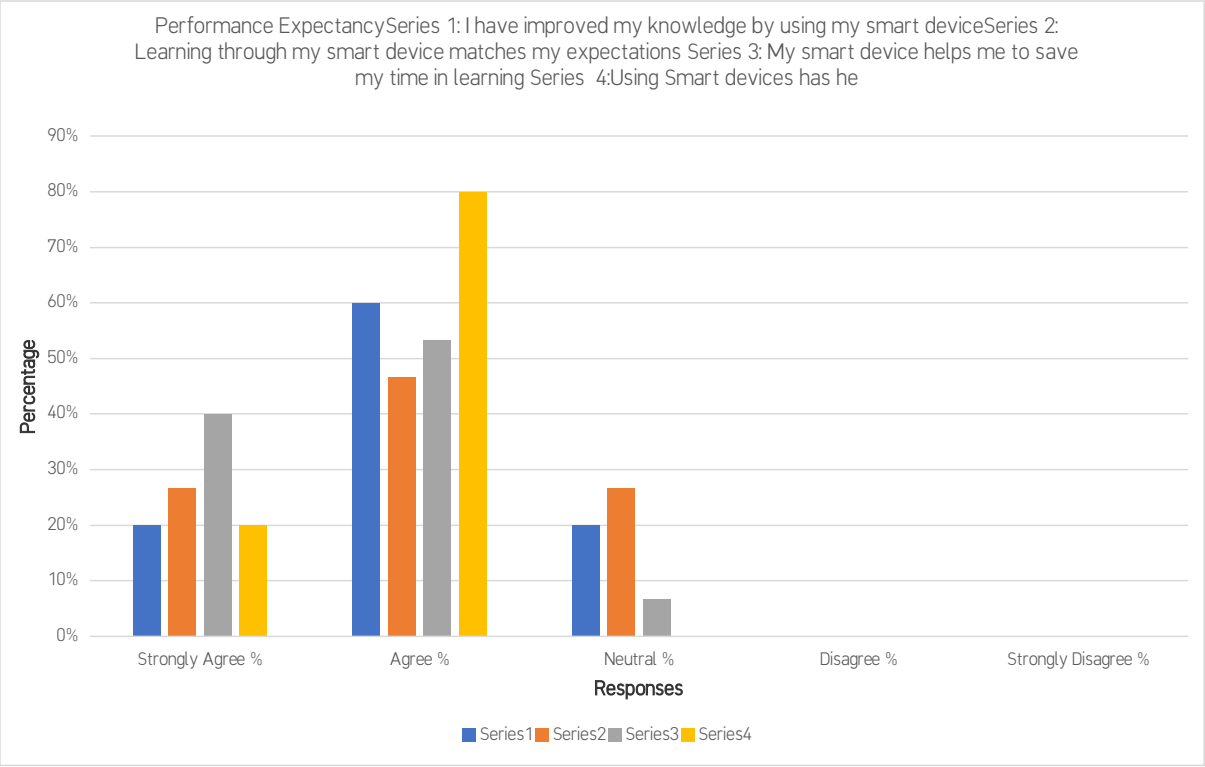


Figure 4.4 Chart showing the response of students regarding their performance expectancy in

using the smart devices as e-learning tools

Inhibiting conditions

The study investigated two inhibiting conditions namely: lack of sufficient resources and necessary knowledge to use smart devices as e-learning tools. The two questions posed to the respondents corresponded to these sub-variables. As indicated in the chart, a significant number of respondents reported that devices were so costly that they found it difficult to afford and use them. This portion represented 33% of the respondents. 27% disagreed that they lacked the resources to purchase the devices. As such, it was evident that the cost of the methods and availability of resources are significant inhibiting factors to the adaptation of the methods as e-learning tools. 86% disagreed with the question that they lacked sufficient knowledge on the use of the devices. Only 7% agreed that they lacked the requisite knowledge to use the devices effectively. Therefore, inhibiting conditions played a part in influencing the students' intention to use the methods as e-learning tools.

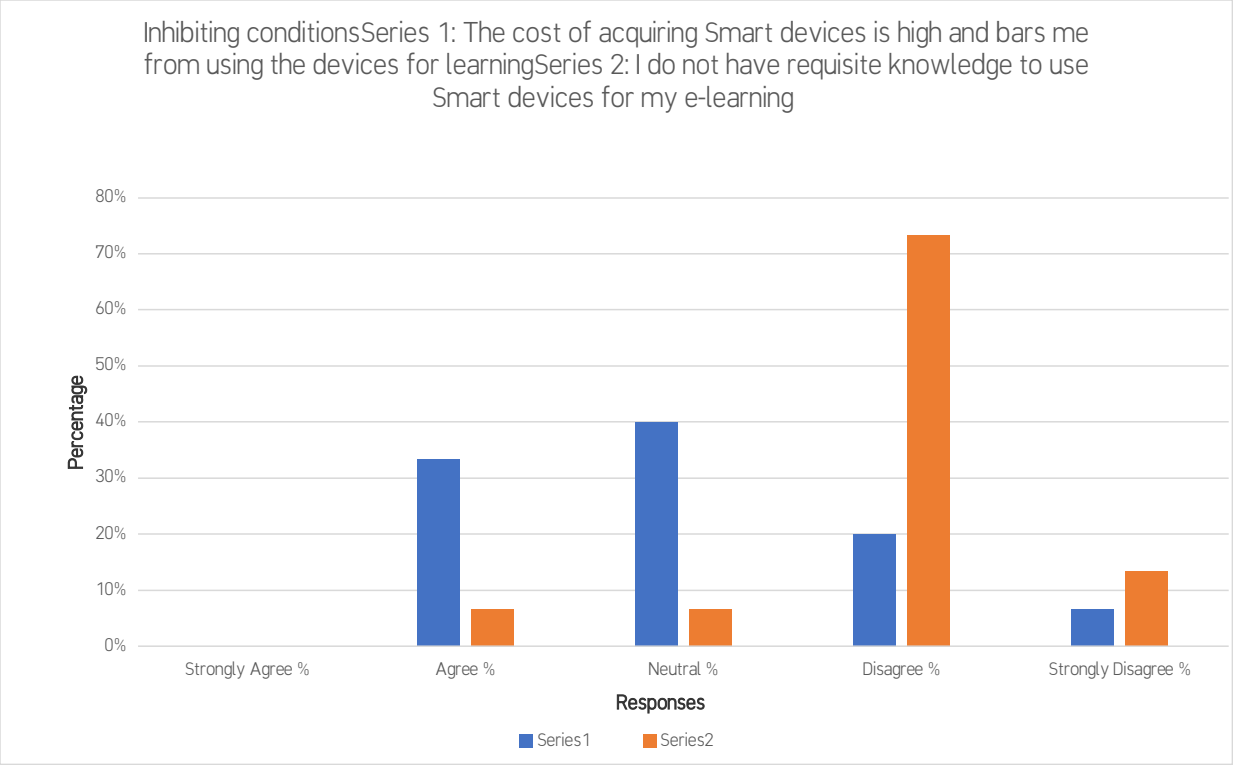


Figure 4.5 Chart showing the response of students to the questions regarding the inhibiting conditions

The data collected for the study was subjected to the MS Excel to obtain the descriptive analysis results. As mentioned, a total of 430 questionnaires were submitted to the students. Out of these, 394 of the questionnaires were used for analysis. In the questionnaires, the first

five questions focused on general questions and individual attributes. The last 11 questions focused on the different variables under investigation in the study. The summary statistics in form of percentages, are shown below:

	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %	Total
Question 6	66%	34%	0%	0%	0%	100%
Question 7	40%	53%	7%	0%	0%	100%
Question 8	27%	60%	13%	0%	0%	100%
Question 9	7%	47%	33%	13%	0%	100%
Question 10	13%	60%	20%	7%	0%	100%
Question 11	13%	46%	41%	0%	0%	100%
Question 12	20%	60%	20%	0%	0%	100%
Question 13	27%	46%	27%	0%	0%	100%
Question 14	40%	53%	7%	0%	0%	100%
Question 15	20%	80%	0%	0%	0%	100%
Question 16	0%	33%	40%	20%	7%	100%
Question 17	0%	7%	7%	73%	13%	100%

Based on the percentages of the students who agreed to the questions posed, the study observed that all the variables being investigated had an impact on the intention to use the smart devices for e-learning. As such, the intention to use the smart devices as e-learning tools was positively influenced by the perceived mobility, presence of facilitating conditions, and high performance expectancy. On the other hand, inhibiting conditions were an impediment to the use of the devices by the RVTTI students.

4.2 Results for Objective two

The second objective of this study sought to establish an adoption model that could be used to guide the adoption of smart Devices in RVTTI. The model was established through association analysis of the variables. The primary technique used was correlation analysis.

The values obtained for each of the independent variable were regressed against those for the dependent variable. The correlation values were obtained between the variables as follows:

Strength of Relationship between the intention to use smart devices and independent variables

As mentioned, regression analysis was applied to assess the relationship between the variables of study. To establish the power of the relationship between different variables, the study used the correlation function and obtained the following results. Each table shows the correlation r between the user intention and the respective independent variable:

Correlation between the user intention and Mobility of Smart devices

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.82172	1

The correlation matrix above was obtained from Ms. Excel analysis. After running the correlation analysis, the study obtained the R-value of 0.82172

Correlation between the user intention and Ubiquitousness of Smart devices

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.5976	1

This correlation matrix shows a fairly strong positive relationship between the intention to use smart devices for e-learning and the ubiquitousness of the devices.

Correlation between the user intention and Availability of resources to facilitate the use of Smart devices

	Column 1	*Column 2*
Column 1	1	1
Column 2	0	1

This correlation matrix showed zero r value. This means that availability of resources had no effect on the intention of the students to use the smart devices.

Correlation between the user intention and Sufficient Requisite knowledge of Smart devices

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.316228	1

The correlation value between the user intention and sufficient requisite knowledge is 0.316. This makes the sub-variable to be significant to the adoption model.

Correlation between the user intention and the fact that smart devices allow students

improve their knowledge

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.16855	1

The correlation matrix shows an R-value of 0.16655 between the user intention and improvement of knowledge, by the students.

Correlation between the user intention and the fact that smart devices allow students improve their knowledge

	Column 1	*Column 2*
Column 1	1	1
olumn 2	0.456435	1

The correlation matrix shows a fairly strong positive degree of relatedness between the user intention by the students, and the improvement of knowledge through smart-devices.

Correlation between the user intention and students' met expectations

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.559017	1

The correlation matrix from Ms. Excel shows that students' met expectation was one of the determinants of their behavioral intention to use the devices. As such, performance

expectancy was a significant factor.

Correlation between the user intention and time saving by students

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.82172	1

The correlation between the intention of students to use the smart devices and the time saving by the devices was 0.82172. This implied that their decision strongly depended on whether the devices would significantly save their time.

Correlation between the user intention and improved academic performance

	Column 1	*Column 2*
Column 1	1	1
Column 2	0.484123	1

Based on the R-value in this matrix, there was a moderately positive relationship between improved academic performance and the intention of the Students to use the smart devices.

Correlation between the user intention and Lack of sufficient Knowledge

	Column 1	*Column 2*
Column 1	1	1
Column 2	-0.49386	1

The correlation matrix shows that there was a relatively weak negative relation between the user intention by the students and lack of sufficient knowledge.

The correlation results indicated that there was a healthy positive relationship between the intention to use smart devices and their mobility, with the R-value of 0.8217. The correlation between user intention and time saving by students was found to be 0.82, indicating a healthy positive relationship. The plan to use smart devices had a reasonably strong correlation with: Ubiquitousness of Smart devices (0.5976), met expectations (0.5590) and Improved academic performance, (0.4841). Additionally, there was a weak correlation between the student's intention to use the devices and Sufficient Requisite knowledge of Smart devices (0.3162), Compatibility of Smart devices with e-learning content (0.16855). However, there was no relationship between the intention to use the tools and the Availability of resources to facilitate the use of Smart devices, as indicated with the R-value of zero. Furthermore, the plan to use smart devices as e-learning tools had a negative relationship with Lack of sufficient Knowledge (-0.49386) and (Non-affordability of the smart devices -0.43853)

From the correlation analysis, it was evident that other variables, then inhibiting conditions affect the intention of students to use the methods as e-learning tools.

The correlation r for inhibiting conditions was -0.493. The r value for Perceived Mobility value, Facilitating Conditions, and Performance Expectancy were 0.82, 0.3162 and 0.4928 respectively. Based on the association analysis results presented, the adoption model was developed. The model is as shown below:

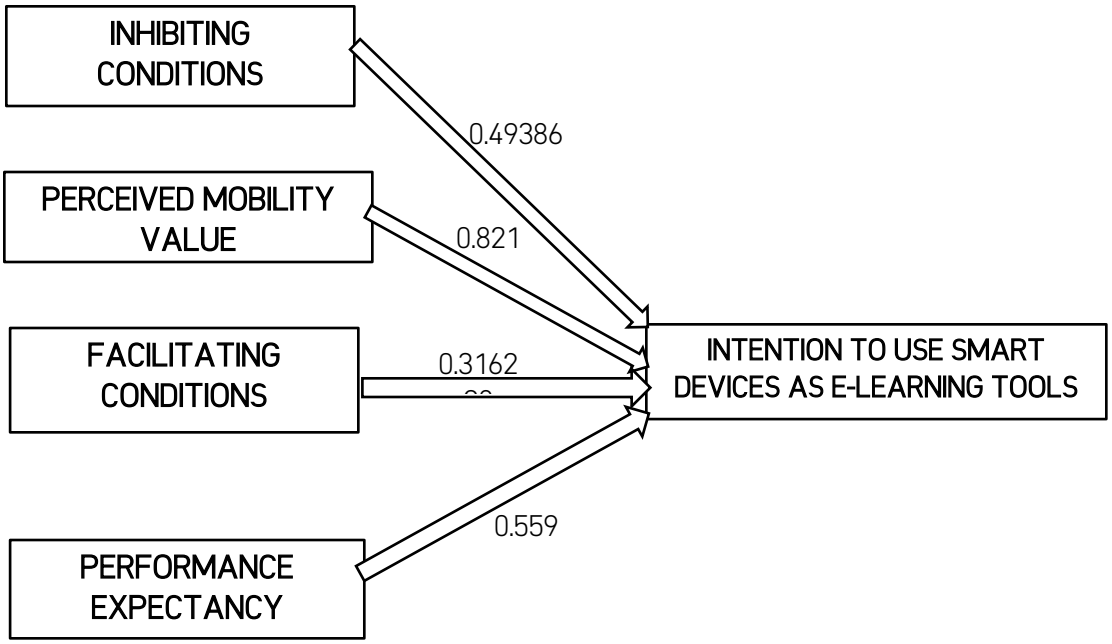


Figure 4.6 Adoption model used for adoption of smart devices as e-learning tools

4.3 Results for Objective three

The data collected was subjected to the WEKA machine learning tool, to test the validity of the model. The data in excel were preprocessed and tranformed to clv format, compatible with the software. Using the explorer option of the Weka window, the clv file was loaded as follows:

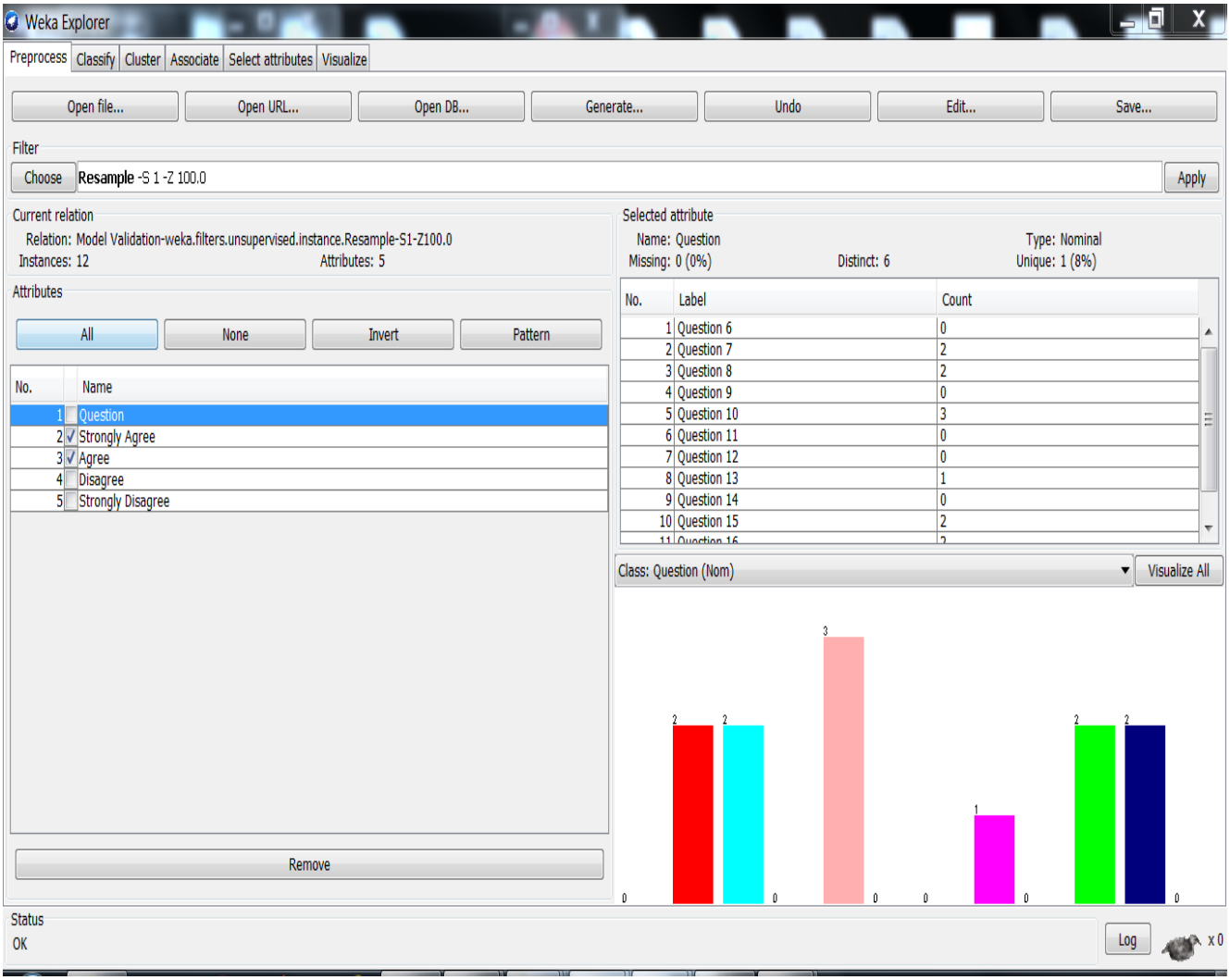


Figure 4.7. The Weka exporer window showing the preprocessed data

Evaluation of the generated model was done using k-fold cross validation. Two folds were used, implying that 50% of the data was used as test set while the remaining 50% used as trainning set. The test used the *Nativebayes* classifier. When the preprocessed data classification was done, The classification output window was displayed as shown below:

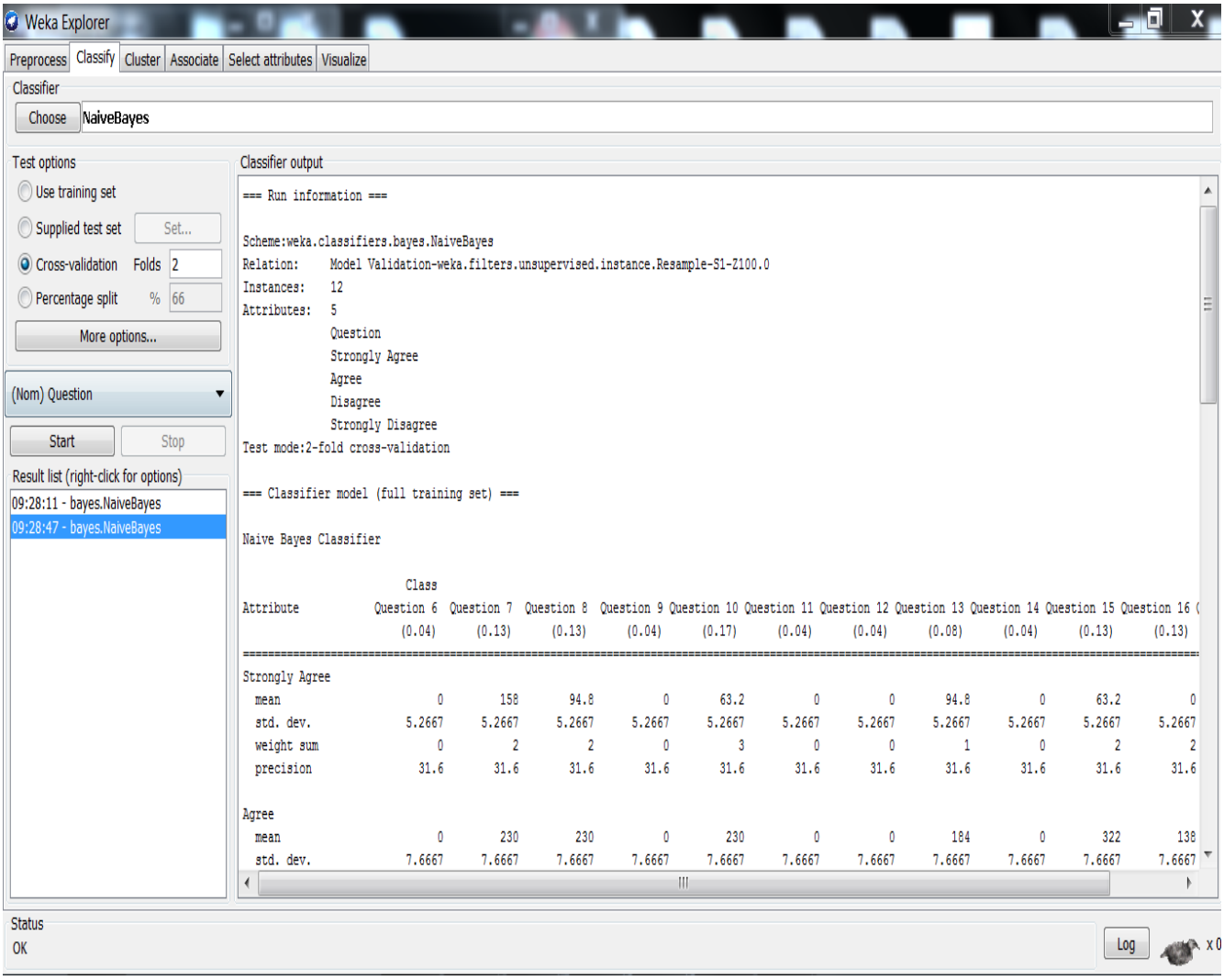


Figure 4.8. The classification output

Evaluation of the model:

To evaluate the model, the three sections of the classification output were interpreted. These sections are the summary, the correctly classified instances and the confusion matrix. Under the summary, the number of correctly classified instances are indicated. Out of twelve instances, eleven were correctly classified, representing 91.6%. 8.3% of the instances were

incorrectly classified. Even though correct classification could not be used to conclude the validity of the model, it was a sign of a good model.

Another significant information under the summary is the Kappa statistic. In our case, the value was 0.8974. This value implied that one would have an 89.74 chance of choosing correctly if they selected an instance at a random. Moreover, this value shows that the classification was accurate, hence a high likelihood of having a correct model.

The 'Detailed Accuracy by Class' is another, equally important section in the classification output. Under this section, the TP (True Positive) Rate has a weighted average value of 0.916. This indicated that 91.6 percent of the items were correctly classified into the right classes. The FP (False Positive) Rate of 0.017 indicated that an insignificant percentage of items were classified in the wrong classes. Besides, the values for Precision and Recall were 0.861 and 0.916 respectively. Since the values were higher than 0.5, the classifier was relatively accurate. The F-Measure value of 0.883 is the harmonic mean of the Precision and Recall values. The ROC area is a measure of accuracy. In our case, the value was 0.947. This implied that the classifier was highly accurate.

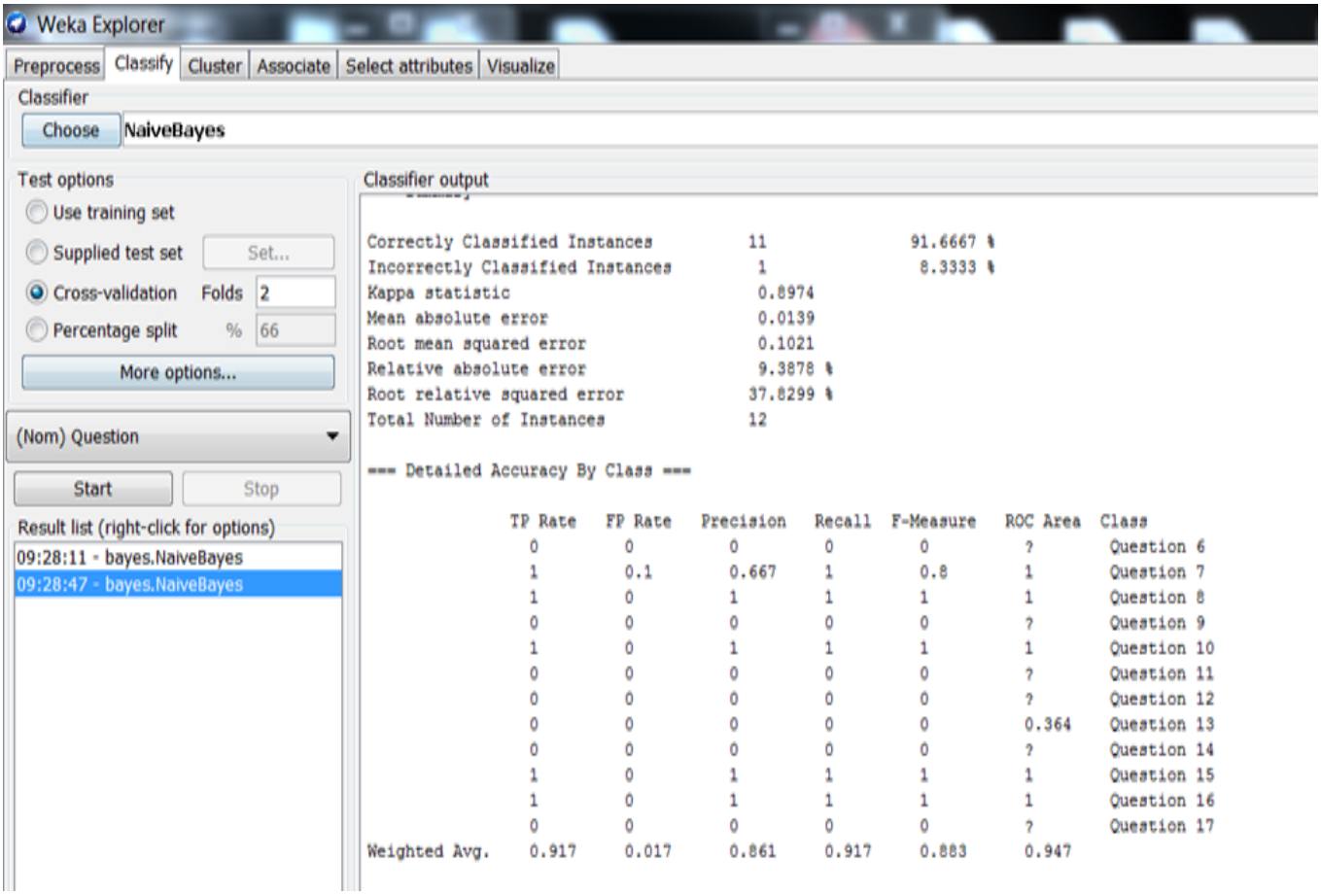


Figure 4.9 Detailed accuracy by class

Based on these indicators, the study concluded that the model developed was valid.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This chapter presents the summary, conclusion, and recommendation of the study. The

objective of the study was to investigate and identify the factors influencing student's intentions to use smart devices as e-learning tools among the students in RVTTI. The findings of this study were consistent with those of Venkatesh et al (2012) that numerous factors were influencing the intention to use smart devices. Both the previous study and this study indicated that Performance Expectancy positively affected the intention of students to use the smart devices, Perceived Mobility value, Confirmation, and Satisfaction. Other studies also suggested that facilitating conditions such as availability of resources and requisite knowledge had a positive influence on the student intends to use the devices for their learning activities in TVET institutions. Empirical studies had, however, not been clear on the effect of individual attributes and inhibiting conditions on the user intends to use the devices. This study established that inhibiting factors also played a vital role in determining the use of the tools.

Other studies conducted previously included those of Huang et al. (2007) and Venkatesh et al (2012) which focused on acceptance on technology on other areas. Their findings were in tandem with those of this study. In particular, perceived mobility and performance expectancy had a positive influence on the user intention.

Another aim of the study was to establish an adoption model to guide the adoption of the Smart Devices as e-learning tools in RVTTI. The adoption model created incorporated four factors namely: Perceived Mobility Value, Facilitating Conditions, Performance Expectancy, and Inhibiting conditions. Furthermore, the model had several sub-variables which include ubiquitousness of the devices, availability of resources, sufficient requisite knowledge, time-saving, academic performance as well as the cost of the smart devices. All these factors influence the intention to use the tools to varying degrees.

The second objective of the study was to evaluate the established model. To meet the goal, the collected data were subjected to statistical analysis of correlation and descriptive statistics. The investigation found that each of the variables influenced the intention of students to use the devices. Using correlation analysis, the study inferred that mobility of the tools and their ability to save time made the students want to use the devices more. The correlation value for the two variables was 0.821 and 0.82 respectively. Furthermore, there was a relatively strong positive correlation between the intention to use the devices and Ubiquitousness of Smart devices met expectations, and Improved academic performance. The correlation r between the user intention and the three variables were: 0.5976, 0.5590 and 0.4841 respectively. Requisite knowledge about the smart devices and their compatibility with the e-learning content also influenced the intention of the students to use the gadgets. However, non-affordability of the tools and lack of sufficient knowledge were negatively related to the intention of the students to use the devices.

The study also sought to evaluate the established model. After identifying the factors affecting the intention to use devices for e-learning, it evaluation of the model's validity was vital. Through the k-fold cross validation, the study observed that the model was valid.

5.2 Conclusion

The aim of the study was to investigate and establish various factors that influence the intention of the students in RVTTI to use smart devices as e-learning tools. The study concluded that Perceived Mobility of the devices, performance expectancy, Facilitating Conditions and Inhibiting conditions influenced their intention to use the devices. The survey concluded that students would continue to use smart devices for e-learning is they could use

them at any place and any time. The correlation between the user intention and the mobility is 0.821, which showed a healthy positive relationship. They would use the devices if they considered them to be ubiquitous to their e-learning activities.

The study also concluded that the students would consider using the devices if they would save time by using them. This conclusion was based on the high positive degree of relatedness between the intention and the ability of the devices to help the students save their time in learning. Furthermore, the students would continue using the tools if their expectations were met. The correlation between the user intention and met expectation was 0.5590, which was a relatively substantial degree of relatedness. Other than their met expectations, the study concluded that the students would use the devices if they aided them to improve their academic performance. Based on the descriptive statistics, 93% of the students who participated in the survey indicated that the smart devices enabled them to improve their academic performance. However, the report observed that the availability of resources to facilitate the use of the smart devices is an insignificant factor in determining the user intention. Additionally, the survey concluded that the costliness of the smart devices and lack of requisite knowledge to use them for e-learning was negatively correlated to the user intention. Based on the descriptive statistics, 86% of the respondents disagreed that their lack of sufficient knowledge prevented them from using the devices. Furthermore, they were almost indifferent as to whether the machines were so costly that they could not afford.

Regarding the second objective of the study, the study concluded that the adoption model incorporated the factors investigated by the survey. The adoption model contains the user intention as the dependent variable and Perceived mobility, performance expectation,

facilitating conditions and inhibiting conditions as dependent variables.

5.3 Contributions of the study

The study contributed to the existing knowledge on adoption and use of technology by improving on the existent models. The models which were improved include: Technology Acceptance Model (TAM) Unified Theory of Acceptance, the Usage Technology model (UTAUT) and Expectation-Confirmation Theory (ECT). Both the TAM and UTAUT model focused on the adoption of a new technology. The study extended these models by incorporating the post-acceptance use of the technology. As noted, students in TIVET institutions had already acquired some devices and were already using them. The study therefore described the factors which contributed to their intention to continue using the devices. The study also introduced some variables which were missing in the previous models. The variables introduced were the individual variables and inhibiting conditions. Under the inhibiting conditions, the study specified limited knowledge and resources as the main aspects influencing the use of the Smart Devices in e-learning. The variable was relevant because most of the students came from low-income homes where they could not afford the devices. Furthermore, the ICT infrastructure in the country was still developing, and thus limited knowledge was another important factor.

In the previous studies, some vital factors affecting the use of the smart devices were not statistically significant. Aziz observed that "Effort Expectancy, Social Influence, Facilitating Conditions and Hedonic Motivation" (2015) were not statistically significant. This study therefore investigated these factors in the RVTTI setting and observed that they were significant. Performance expectancy, inhibiting conditions, perceived mobility, and various

facilitating conditions were found to be influencing user intention in adoption of smart devices as e-learning tools.

5.4 Policy Recommendations

Based on the findings of the survey, the study made the following recommendations:

Firstly, the learning institution had to customize their e-learning content to ensure that it was compatible with the smart devices. This move by the institution would ensure that the tools were user-friendly to the students. As such, it would influence more students to acquire and use the devices to improve their learning.

Secondly, the institution would train the students on how to effectively use the smart devices. As mentioned previously, some students indicated that they do not have sufficient requisite knowledge on how to use the tools. As such, they cannot get the best from the devices. Using them effectively will help them improve their academic performance and meet their educational goals.

Thirdly, the government would subsidize the devices to make them affordable to the TIVET students. As noted, the institutions help to equip the students with technical skills to improve their employment prospects, as well as prepare them for self-employment. The survey on RVTTI students indicated that some students find the devices costly. The government, through the Ministry of Education, Science and Technology would set aside some funds to subsidize the products. By making them affordable, all students would acquire them and improve their learning in technical institutions.

Recommendation for future study

Future studies can incorporate larger sample to create findings that are representative of the population. As noted, this study used non probability samples due to the constraint of time and resources. Future studies should focus on more users and higher education scholars to get a general view of the use of the devices for e-learning.

Furthermore, future studies could investigate the aspects of age and gender, which were narrowly addressed by this study. The underlying assumption was that the range in the age of students was narrow. As such, it was statistically insignificant during the study. By investigating these variables, the studies can cover many areas, other than the technical institutions.

References

Ahuja, M.K. and Thatcher, J.B., 2005. Moving beyond intentions and toward the theory of trying:

effects of work environment and gender on post-adoption information technology use. *MIS quarterly*, *29*(3), pp.427-459.

Akemi Yonemura, Ed.D., UNESCO-IICBA. 2011. The Role of Teacher Training in Technical and Vocational Education and Training (TVET) in Africa. International Institute for Capacity Building in Africa.

Al Saif, A.A., 2005. *The motivating and inhibiting factors affecting the use of web-based instruction at the University of Qassim in Saudi Arabia* (Doctoral dissertation, Wayne State University).

Anderson, Terry. 2008. The Theory and Practice of Online Learning. 1 University Dr, Athabasca, AB T9S 3A3, Canada: Athabasca University Press.

Aziz, N., 2015. Smart Devices as U-Learning Tools: Key Factors Influencing Users' Intention.

Bhattacherjee, A. (2001). Understanding information systems continuance. *MIS Quarterly*, 25(3), 351–370.

Fuster, G. G., & Scherrer, A. (2015). Big Data and smart devices and their impact on privacy. *Committee on Civil Liberties, Justice and Home Affairs (LIBE), Directorate-General for Internal Policies, European Parliament. See http://www. europarl. europa. eu/RegData/etudes/STUD/2015/536455/IPOL_STU (2015) 536455_EN. pdf (accessed 4 November 2015)*.

Bebell and, C.L.C. and O'Dwyer, J.A., 2010. Effectiveness of computer-based instruction: An updated analysis. *Computers in human behavior*, *7*(1), pp.75-94.

Caballé, S., Xhafa, F. and Barolli, L., 2010. Using mobile devices to support online collaborative

learning. *Mobile Information Systems*, *6*(1), pp.27-47.

Dara Tafazoli, Margarida Romero. 2016. Multiculturalism and Technology-Enhanced Language Learning, Advances in Educational Technologies and Instructional Design Series. 701 E Chocolate Ave #200, Hershey, PA 17033, USA: IGI Global.

Davis, F. D (1989). Perceived usefulness, perceived ease of use, and user acceptance of information

technology. *MIS Quarterly*, 13(3), 319–340

El-Hussein, M.O.M. and Cronje, J.C., 2010. Defining mobile learning in the higher education landscape. *Educational Technology & Society*, *13*(3), pp.12-21.

Falloon, G., 2013. Young students using iPads: App design and content influences on their learning pathways. *Computers & Education*, *68*, pp.505-521.

Fleischer, R.A., Pople Jr, H.E. and Myers, J.D., 2012. Internist-I, an experimental computer-based diagnostic consultant for general internal medicine. *New England Journal of Medicine*, *307*(8), pp.468-476.

Frohberg, Goth, and Shortliffe, E. ed., 2009. *Computer-based medical consultations: MYCIN* (Vol. 2). Elsevier.

Gillet, D., El Helou, S., Yu, C.M. and Salzmann, C., 2008, February. Turning Web 2.0 social software into versatile collaborative learning solutions. In *Advances in Computer-Human Interaction, 2008 First International Conference on* (pp. 170-176). IEEE.

Goerke, V. and Oliver, B., 2007. Australian undergraduates' use and ownership of emerging technologies: Implications and opportunities for creating engaging learning experiences

for the Next Generation. *Australasian Journal of Educational Technology*, *23*(2), p.171.

Hwang and Nii, H.P. and Aiello, N., 2011, August. AGE (Attempt to Generalize): A knowledge-based program for building knowledge-based programs. In *Proceedings of the 6th international joint conference on Artificial intelligence-Volume 2* (pp. 645-655). Morgan Kaufmann Publishers Inc.

Jammes, F., Mensch, A. and Smit, H., 2005, November. Service-oriented device communications using the devices profile for web services. In *Proceedings of the 3rd international workshop on Middleware for pervasive and ad-hoc computing* (pp. 1-8). ACM.

Larose, Daniel T. 2005. Discovering Knowledge in Data: An Introduction to Data Mining. John Wiley & Sons.

Milrad, M. and Spikol, D., 2007. Anytime, anywhere learning supported by smart phones: Experiences and results from the MUSIS project. *Educational Technology & Society*, *10*(4), pp.62-70.

Mtega, W.P., Bernard, R., Msungu, A.C. and Sanare, R., 2012. Using mobile phones for teaching and learning purposes in higher learning institutions: The case of Sokoine University of Agriculture in Tanzania. In *Proceedings and report of the 5th UbuntuNet Alliance annual conference* (pp. 118-129).

Nortcliffe, A. and Middleton, A., 2013. The innovative use of personal smart devices by students to support their learning. In *Increasing student engagement and retention using mobile applications: Smartphones, Skype and texting technologies* (pp. 175-208). Emerald Group Publishing Limited.

Penuel, S.K., McDonnell, D.D., Kazinets, G., Seo, H.G. and Moskowitz, J.M., 2006. Effects of Web-

and computer-based smoking cessation programs: meta-analysis of randomized controlled trials. *Archives of internal medicine*, *169*(10), pp.929-937.

Peters, K., 2007. m-Learning: Positioning educators for a mobile, connected future. *The International Review of Research in Open and Distributed Learning*, *8*(2).

Pilz, Matthias. 2012. The Future of Vocational Education and Training in a Changing World. Springer Science & Business Media.

Remote Workforce Training: Effective Technologies and Strategies: Effective Technologies and Strategies; Advances in Business Information Systems and Analytics. 2014. 701 E Chocolate Ave #200, Hershey, PA 17033, USA: IGI Global.

Shabtai, A., Kanonov, U., Elovici, Y., Glezer, C. and Weiss, Y., 2012. "Andromaly": a behavioral malware detection framework for android devices. *Journal of Intelligent Information Systems*, *38*(1), pp.161-190.

Shaozi Li, Qun Jin, Xiaohong Jiang, James J. Jong Hyuk Park. 2013. Frontier and Future Development of Information Technology in Medicine and Education: ITME 2013. Springer Science & Business Media.

Stankovic, J.A., 2008. Wireless sensor networks. *computer*, *41*(10).

Tvetauthority. 2016. About. [online]. [Accessed Tuesday February 2017]. Available from World Wide Web: http://tvet.gov.mv/about/

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 36(1),
157-178.

Vladimir L. Uskov, Robert J. Howlett, Lakhmi C. Jain. 2015. Smart Education and Smart e-Learning. 11 W 42nd St, New York, NY 10036, USA: Springer.

Wong, G.A., 2010. A practical computer-based approach to the analysis of radioligand binding experiments. *Computer programs in biomedicine*, *17*(1-2), pp.107-113.

Wu, W.H., Wu, Y.C.J., Chen, C.Y., Kao, H.Y., Lin, C.H. and Huang, S.H., 2012. Review of trends from mobile learning studies: A meta-analysis. *Computers & Education*, *59*(2), pp.817-827.

Yau, S.S., Gupta, S.K., Karim, F., Ahamed, S.I., Wang, Y. and Wang, B., 2003, June. Smart classroom: Enhancing collaborative learning using pervasive computing technology. In *ASEE 2003 Annual Conference and Exposition* (pp. 13633-13642).

Yong Wee, S., Siong Hoe, L., Kung Keat, T., Check Yee, L. and Parumo, S., 2011. Prediction of user acceptance and adoption of smart phone for learning with technology acceptance model. *Journal of Applied Sciences*, *10*(20), pp.2395-2402.

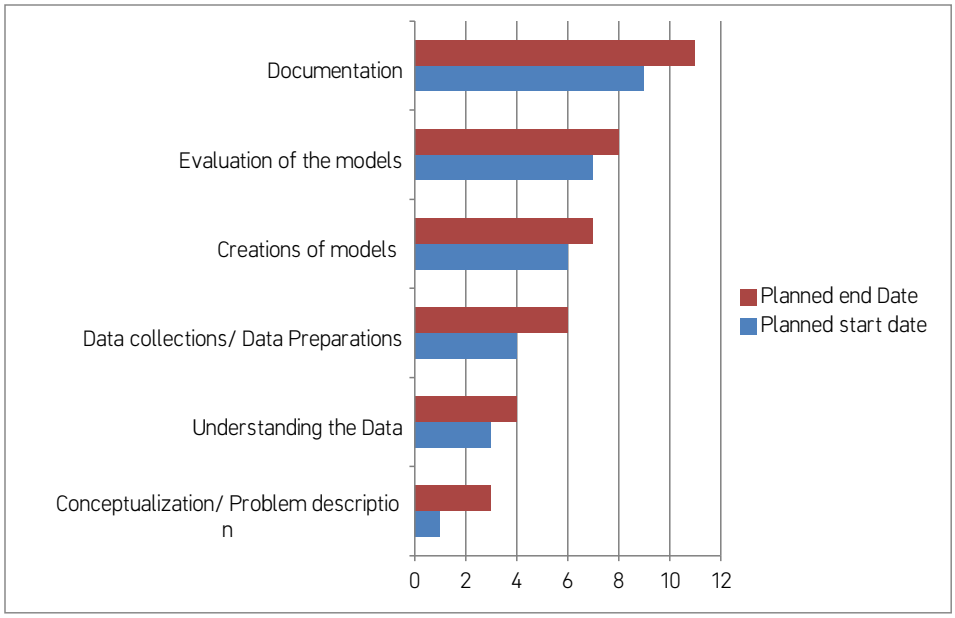
Zucker,L.A., 2009. Meta-analytic studies of findings on computer-based instruction. *Technology assessment in education and training*, *1*, pp.9-34.

Appendix 1 (Proposed Timeline)

Task no	Task Name	Planned start Date	Planned end date
1	Conceptualization/ Problem description	January	March
2	Understanding the Data	March	April
3	Data collections/ Data Preparations	April	June
4	Creations of models	June	July
5	Evaluation of the models	July	August
6	Evaluation of the models	August	September
7	Documentation	September	November

Appendix II

Gantt chart



Appendix III

Expenses

Components	Descriptions	Costs (ksh)
Proposal Writing	Literature research and review in libraries, internet services, stationery (Photocopy, note pads, clip board, pens and typesetting)	5000.00
Data Collection	Investigator's Expenses • Travelling expenses • Accommodation • Food and Drinks • Printing and photocopying • Permits	 10000.00 15000.00 5000.00 5000.00 1000.00
Thesis writing	Stationery expenses • Printing cost • Photocopying cost • Bindery costs	 1000.00 500.00 800.00
Totals		**48300.00**

Appendix 4. Questionnaire questions

Please check the appropriate option in the following questions: Only check one response in every question.

A. GENERAL QUESTIONS REGARDING DEMOGRAPHICS OF RESPONDENTS

1)

DEPARTMENT	TICK
Information Communication Technology Department	( )
Building & Civil Engineering	( )
Business and Development Studies	( )
Electrical & Electronic Engineering	( )
Mechanical & Automotive Engineering	( )
Medical and Biological Sciences Department	( )
Pharmacy and Chemical Science Department	( )
Hospitality & Dietetics Management	( )

2) Do you use smart devices your e-learning? (Note: you should be a student at RVTTI in order to take part in the survey)

Yes ( ) No ( )

B. INDIVIDUAL ATTRIBUTES

3) Indicate your suitable age group?

Less than 18 ( )

18-24 ( )

25-28 ( )

29-34 ( )

Older than 35 ( )

4) What is your gender?

Female ( ) Male ( )

5) How long have you used Smart learning devices as e-learning tools?

Less than 6 Months ( )

6-12 Months ( )

13-18 Months ( )

More than 18 Months ( )

C. INTENTION TO USE SMART DEVICES AS E-LEARNING TOOLS

6) I intend to use smart devices as e-learning tools.

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

D. PERCEIVED MOBILITY VALUE

7) Mobility of my smart device allows to accomplish tasks quickly - any place, anytime.

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

8) Using my smart device enables me to study anytime, anywhere (ubiquitous)

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

E. FACILITATING CONDITIONS

9) I have the resources necessary to use my smart device as a learning tool

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

10) I have sufficient knowledge necessary to use my smart device as a learning tool

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

11) I consider the e-learning content compatible with the smart devices.

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

F. PERFORMANCE EXPECTANCY

12) I have improved my knowledge by using my smart device

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

13) Learning through my smart device matches my expectations

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

14) My smart device helps me to save my time in learning

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

15) Using Smart devices has helped me improve my academic performance

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

G. INHIBITING CONDITIONS

16) The cost of acquiring Smart devices is high and bar me from using the devices for learning

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )

17) I do not have requisite knowledge to use Smart devices for my e-learning

Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree ( )