



UNIVERSITY OF NAIROBI

COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES

SCHOOL OF COMPUTING AND INFORMATICS

E-Learning as a Tool to Improve STEM Performance among Girls in Secondary
Schools

Case of Kariobangi North Girl's Secondary School

By

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Master of Science in Applied Computing, in the School of Computing and Informatics,
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Declaration

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

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Dedication

I dedicate this project to my creator, my powerful pillar, my source of inspiration, wisdom, knowledge and comprehension, God the Almighty. He has been the source of my strength throughout this program and I have only soared on His wings.

I also dedicate this research to my family who supported me to conduct this research, for the lecturers who helped and guided me to make a final output and for the future researchers who can use this research as their guide or reference.

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Finally, I would like to thank all interviewees, the questionnaire respondents of Kariobangi North Girls Secondary School for their contribution towards this research.

Abstract

With our society progressively dependent on technology and STEM literacy, closing the dramatic gender divide within STEM areas becomes even more essential. Microsoft's latest research discovered that girls and young females tend to lose interest in STEM areas as they age. The interest falls considerably as soon as they complete high school. 57 percent of girls believed that engineering was more for boys when questioned, although countless surveys discovered no important gender differences in engineering aptitude. That implies the stereotypes need to be broken! The latest growth of ICTs in various industries has brought many changes. Higher learning institutions are experiencing several useful modifications. ICTs have provided the key tasks of teaching, outreach, research and consultancy with efficiency, effectiveness and efficiency. Previous studies have shown that while there is improvement in teaching and learning through e-learning, few studies have studied e-learning as an instrument to promote the participation of female learners in the fields of science, technology and mathematics. The aim of this qualitative research is to determine how high schools through e-learning technology can best prepare and encourage young females to work in STEM subjects. In this regard, this research seeks to determine whether e-learning could be an effective resource for self-learning for girls in secondary schools to improve performance in Mathematics and other STEM subjects.

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Definition of Terms

Learning: Learning is the method by which current knowledge, behaviors, abilities, values or preferences are acquired or modified. People, livestock, and some machines possess the capacity to learn; in some crops there is also proof of some kind of teaching.

Adoption: Adoption is a method by which an individual assumes the parenting of the biological or legal parent or relatives of another individual, generally a child. Legal adoptions permanently transfer all rights and duties from the biological parent or parents, together with filiation

e-learning - learning conducted via electronic media, typically on the Internet. E-Learning is using electronic technology to access the curriculum outside the traditional classroom. In most instances, it relates to a complete internet course, program or degree.

e-platform - Is an integrated collection of interactive internet facilities that provide data, instruments and resources for trainers, students and others engaged in education to promote and improve the delivery and management of education.

Innovation - Deliberate use of information, imagination and initiative to derive higher or different values from resources, including all procedures through which fresh ideas are created and transformed into helpful products

Synchronous Learning - A course structure that dictates that students must simultaneously access and eat an online course regardless of place. Synchronous learning enables teachers and learners to interact in real time, while asynchronous learning does not

Asynchronous Learning - The ability for learners to access and consume an online course at different times. This is a core concept in elearning and Web Based Training (WBT) and allows a course to be delivered at a pace that suits each individual learner

Blended Learning - A syllabus of education that combines various kinds of media with a mixture of offline and internet teaching ; often a mixture of school settings and elearning.

Micro Learning - A method of providing users with content in tiny, particular bursts, enabling users to regulate what and when they learn. For example, it is possible to deliver a piece of educational content or information in the size of a tweet.

Abbreviations and acronyms

STEM – Science, Technology, Engineering and Mathematics

LMS - Learning Management System

VR and AR - Virtual and Augmented Reality

CDT – Component Display Theory

TOE – Technology–Organization–Environment framework

RUP – Rapid Unified Process

TRA – Theory of Reasoned Action

ITU – International Telecommunications Union

GSMA - GSM (Groupe Spéciale Mobile) Association

ICT – Information and Communications Technology

ROI – Rate on Investment

DOI – Diffusion of Innovation

HCI – Human Computer Interface

SMS – Short Message Service

PHP - Hypertext Preprocessor (HTML-embedded scripting language)

HTML - Hypertext Mark-up Language

CSS - Cross Site Scripting

CAT – Continuous Assessment Test

CAK – Communications Authority of Kenya

HTTP - Hypertext Transfer Protocol

CHAPTER ONE

INTRODUCTION

1.1 Background

From time immemorial education has always been recognized as the bedrock of national development. With our society progressively dependent on technology and STEM literacy, closing the dramatic gender divide within STEM areas is becoming even more essential. A latest Microsoft research discovered that as they age, girls and young females tend to lose interest in STEM fields.

57 percent of kids believed that engineering was more for boys when questioned, although countless surveys discovered no important gender differences in engineering aptitude. That implies breaking stereotypes!

1.1.1 Gender Equity in Kenya

Gender equity is termed as the unbiased treatment of females and males to guarantee equal enjoyment of both gender members' rights and privileges. This has been a contentious topic in Kenyan culture since the nation gained its independence. (Athimoolam and Kibui, 2014)

The topic is constantly challenged by difficulties and obstacles that not only make it more hard for the country to make progress towards achieving gender equity, but also continue to limit the development of the country, in either the political, or social-economic fields envisaged in Kenya's 2030 vision of economic growth.

These difficulties include traditional and cultural methods, fast development of the population, religion, poverty, disease, etc. Despite the above-mentioned problems, the nation has made tremendous strides in attempting to attain gender equity in all industries, including education, and this is due to numerous attempts by all stakeholders to address the many gender issues and concerns experienced in the country.

1.1.2 ICTs in Education

The latest growth of ICTs in various industries has brought many changes. There are several beneficial changes in higher learning institutions. ICTs have provided the key tasks of teaching, outreach, research and consultancy with efficiency, effectiveness and effectiveness. Previous studies have shown that while teaching and learning through e-learning is improved, few studies have investigated e-learning as an important instrument for encouraging the participation of female learners in science, technology and mathematics. (Sanga, Magesa, Chingonikaya & Kayunze, 2016)

1.1.3 STEM

STEM stands for mathematics, science, technology, and engineering. STEM is essential because it's going through every aspect of our life. Science is around us all over the globe. Technology is growing continually in all aspects of our life. Engineering is the fundamental design of highways and bridges, but it also addresses the difficulties of altering worldwide climate and environmental change in our home. In every job, mathematics is every important. By exposing students to STEM and allowing them to explore STEM-related concepts, they will develop a passion for it and hopefully pursue a job in the STEM field

1.1.4 Gender in STEM

For several years, we have heard the warnings that there are merely not enough young researchers on the STEM professional paths to substitute all the retired experts.

STEM education enables bridge the gap between ethnicity and gender that are sometimes discovered in math and science. Initiatives to improve the roles of females and minorities in STEM-related areas have been created. Traditional gender roles are broken by STEM education. STEM schooling and careers must be a domestic concern to compete in a worldwide economy.

1.2 RESEARCH PROBLEM STATEMENT

Despite the many advantages of adoption and usage of e-learning, its execution is still not so successful, especially in developing countries. In addition, there are general reservations in Sub-Saharan Africa about the efficacy of e-learning mode of teaching as compared to the conventional traditional class room methods.

In Kenya, numerous efforts have been made to implement e-learning, particularly at higher education level, but much remains to be done at secondary education level, and with our society increasingly dependent on technology and STEM literacy, closing the dramatic gender gap within STEM fields is becoming even more imperative.

A latest Microsoft research discovered that as they age, girls and young females tend to lose interest in STEM fields. The interest falls considerably as soon as they complete secondary school. On request, 57 percent of pupils believed that engineering was more suitable for boys, although countless surveys discovered no important gender differences in engineering skills.

Previous studies have shown that while there is notable improvement in teaching and learning through e-learning, although few studies have studied e-learning as an instrument for encouraging the participation of female learners in science, technology and mathematics. (Sanga, Magesa, Chingonikaya & Kayunze, 2016)

Girls in high school tend to under-use a lot of time when they are out of school or on short / long holidays because most of them are unable to afford a private tutor to continue to teach them the formal teaching during this period.

The internet is one of the most significant ways of providing learners with learning resources to share and acquire data worldwide, and students today are regarded "digital natives" i.e users who have grown up using computer, mobile and Internet technologies. (Prensky 2001).

Despite this reality, you will discover that most of them are not prepared to use the opportunity to learn and improve their knowledge and confidence on STEM subjects, although they are knowledgeable in technology and have access to the web.

1.3 RESEARCH OBJECTIVES

1.3.1 Main Objective

To determine whether e-Learning could be an effective resource for Self-Learning to improve performance in STEM subjects among girls in secondary schools.

1.3.2 Specific Objectives

The specific objectives were:-

1. To establish what contributes to poor performance in STEM subjects among girls in secondary schools.
2. To propose, deploy and evaluate a suitable e-Learning solution.
3. To validate the prototype based on user feedback

1.4 RESEARCH HYPOTHESES

The research was guided by the two null hypothesis below;

1. e-Learning can be beneficial resource to girls in secondary school for their self-learning to help them improve performance in STEM subjects.
2. Adoption of a suitable e-Learning tool can be beneficial to girls in Secondary schools for Self-study in order to improve confidence and performance.

1.5 RESEARCH SIGNIFICANCE

E-learning system designers would profit considerably from the results of this research to know the attitudes and perceptions of e-learning consumers and adopters. With this knowledge, designers of e-learning systems can develop more user centered e-learning tools to fit the requirements of individual consumers and their target organizations.

Further, the findings of this research would be used as a baseline for E-learning preparedness in Kenyan Secondary Schools, and the levels of computer literacy among the students.

1.6 LIMITATION AND SCOPE

1.6.1 Research Scope

While it would have been very interesting to include all elements of e-learning, it is virtually impossible to explore all e-learning aspects within the moment allowed and the resources available. This implies the research has been narrowed down to a case study of the secondary school of Kariobangi North Girls, Form One Class, with Mathematics selected as the STEM subject

1.6.2 Limitations

In the context of secondary school level of education, the parameters of e-learning are wide and complicated. This means that time, appropriate financing and other logistics are required to perform an efficient extensive survey to cover all of the country's secondary schools. The research was performed with a relatively small target student population. Given the sample size selected as well as the target population regional distribution, the question was could the findings be applicable other girls' secondary schools.

However, inductive generalization involves elaborate research with a larger samples. In addition, due to technological dynamism, some of e-learning results can be rendered meaningless over time. Therefore, generalizations of results should be performed with caution to the learners of other high school girls.

1.6.3 Assumptions

The researcher presumed that the questions will be answered objectively by all participants to the best of their capacities. The researcher will further suppose that owing to gender or physical disability or geographical places, no respondent was disadvantaged. The researcher was able to access the participants without trouble in the centers assigned to them.

1.7 CONCLUSION

To date, Kenya's secondary schools have benefited less from technology and e-learning in particular. If adequate research is conducted to determine which factors that affect its successful implementation and develop strategies for promoting adoption, schools may just begin to enjoy the full benefits of e-learning and ICTs in education.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section describes contributions to literature under the wide heading of the e-learning notion of adoption and utilization in Kenyan Girl's Secondary schools, and strategies being implemented to encourage young girls to embrace STEM subjects.

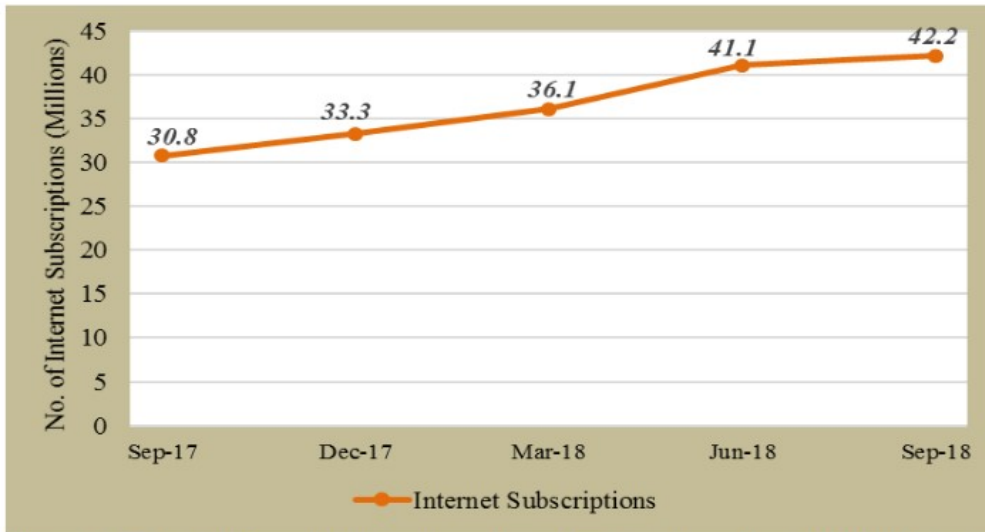
Reasonably good amount of educational research has already been done on the involvement of women in STEM majors and careers. These studies have focused mainly on GPA, standardized test scores, response to failure, mentors, gender disparity and financial aid (Gorman, Durmowicz, Roskes & Slattery, 2010; Inzlicht & Ben-Zeev, 2003; Margolis, Fisher & Miller, 2000; Vest, 1999; Whalen & Shelley, 2010), but there is limited research on what experiences and incentives at the secondary school level propel these young women into the STEM fields.

There is a need for further research how technology and specifically E-Learning can be used as an enabler to increase the number of girls to enhance their interest and performance in STEM subjects.

2.2 Technology Penetration and Adoption

2.2.1 Data/Internet Subscriptions

International Telecommunications Union (ITU) and World Bank statistical data has shown that by increasing the accessibility of broadband networks, major steps can be achieved in increasing Internet access and use. Digital connectivity plays a significant part in life transformation and improvement, as it makes available jobs, economic possibilities and unprecedented expertise for billions of individuals around the world. By the end of September 2018, the report indicated that approximately 42.2 million people were already internet subscribers, up from 41.1 million of June 2018.



Source: CA, Operators' Returns. The information on Internet Penetration has not been included in this report because the Authority is in the process of reviewing the methodology for estimating Internet Users in line with local needs and current market developments. Internet Penetration is calculated as a percentage of active Internet Users in a country

Figure 1: Internet subscription – Source is CAK Report for 2018

2.2.2 Mobile Phones

As of September 30, 2018, there were 46.6 million active phone subscriptions in the nation. This marked an increase of 2.4% compared to 45.5 million subscriptions reported on June 30, 2018. Mobile penetration subsequently increased by 2.3 percentage points from 97.8 percent last quarter to 100.1 percent.

According to the ICT Facts and Figures Report (2005-2017) of the International Telecommunications Union (ITU), in 2003, some advanced nations like Taiwan, Hong Kong and Israel had already surpassed 100% mobile penetration.

These advanced nations had penetration rates of 121.8 percent, 249 percent and 126.7 percent respectively by 2017. Namibia, Morocco and Tunisia are among nations in Africa that have exceeded 100 percent penetration.

2.2.3 Smart Phones Connections

Due to the emergence of cheaper phones, in the last five years, smartphone penetration in Kenya has risen to more than 60 percent of the total population.

In latest years, smartphone connections have risen steadily and are anticipated to double to approximately 200 million over the next 2 years, representing 25% of all mobile connections in 2016. Sub-Saharan Africa's main factors promoting smartphone adoption are mainly motivated by enhancing the smartphone's affordability.

Together with web services, this trend drives demand for digital content and leads to increased mobile information traffic. It is anticipated that internet smartphone traffic will rise 12x in Africa over the next 5 years

A smartphone's average cost has fallen more than half from the Sh23, 100 in 2013 to Sh9,700 in 2016, with Jumia selling the lowest-priced X-Tigi P3 smartphone for Sh2,799. Making a smartphone affordable therefore a reality

2.2.4 Future Projections on Smart Phones Penetrations

According to an ITU 2019 study, by 2025 four of five connections smartphones globally will be smartphone connections. Smartphone connections will more than double in sub-Saharan Africa. By 2025, three fresh superpowers for smartphones will arise.

2025 rank	Country	Smartphone connections, 2025 (m)	Change in rank since 2018
1	China	1,458	=
2	India	1,171	=
3	Indonesia	410	▲1
4	USA	346	▼1
5	Brazil	204	=
6	Russia	187	=
7	Japan	162	=
8	Pakistan	146	▲14
9	Nigeria	143	▲11
10	Bangladesh	134	▲11

Figure 2: Illustration of Smartphone Subscription Projection

2.2.5 Mobile Internet connectivity

As of the fourth quarter of 2017, worldwide mobile internet traffic grew by 11.65 percent year-on-year to 51.12 percent of worldwide smartphone web traffic. Kenya is the world leader in mobile Internet traffic (overtaking Nigeria in 2017) at 83 percent

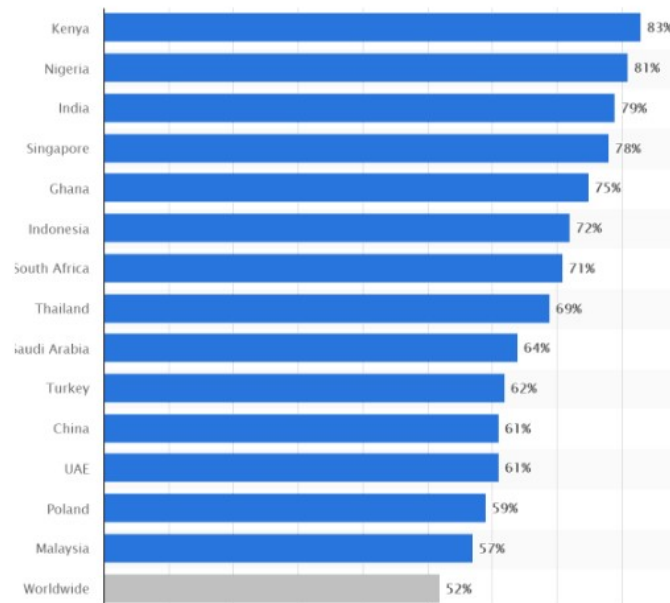


Figure 3: Illustration of Internet Traffic Originating from Smart Phones

2.3 The concept of e-Learning

There is no accurate definition of e-learning as a notion. e-Learning is defined using terminologies like connectivity, access flexibility, ICT infrastructure and delivery of internet content.

E-learning is considered as a way of facilitating and improving learning through the use of computer systems and communications technologies, Salmon (2002). Such systems entails personal computers and communications systems that make use of the internet and other available collaborative software's that promote student team learning.

2.4 e-Learning Status in Kenya

As the Internet continues to shine throughout the country and software and hardware prices fall, e-learning could well become the wave of the future of education.

This does not imply that online education is the panacea for all the ills that haunt education. Online education alone, there will always be a lot of students who can't flourish. To promote teaching, they need a teacher in school and a group of like-minded learners.

While e-learning will not replace classrooms on the ground, Kenya has made remarkable steps towards modernizing education by use of technology.

2.4.1 Current e-Learning Trends

It is not easy to predict learning trends as it may sound, as some of the trends have been around for quite a while, and some have not seen the maturity or traction they need. Include some of the 9 e-learning trends that are growing stronger;

Virtual and Augmented Reality

Currently, the best way to execute training is virtual and augmented reality. There has been Virtual Reality for quite some time now. Nevertheless, we have exciting new options in the immersive learning space with the addition of augmented Reality and Mixed Reality to the mix. VR and AR are traditionally used more for gaming and film experiences.

Intelligent Assistants - Chatbots

Most organizations may attempt to build prototype chatbots for particular subjects, such as safety of information or data protection, compliance, etc. and implement them intelligent search apps

Gamification and Game-Based Learning

Gamification will remain a significant trend in 2018. It is now well established that game-based learning and gamification have a greater impact on the provision of roles-based critical data.

Micro Learning

A method of providing users with content in tiny, particular bursts, enabling users to regulate what and when they learn. For example, it is possible to deliver a piece of educational content or information in the size of a tweet.

Interactive Video-Based Learning

Video-based tutorials continue to expand in popularity on YouTube and other internet video services. Organizations leverage the popularity of videos by shooting their own videos, adding interactivities / questions to them, and then posting the videos on inner locations. There may also be branching scenarios for interactive videos.

2.5 Factors Affecting E-Learning Implementation in Kenya

Availability of ICT Infrastructure

The accessibility of ICT infrastructure is one of the main variables recognized as affecting e-learning efficiency in sub-Saharan Africa, and indeed Kenya. The argument advanced in this article is that e-learning will be facilitated by the accessibility of ICT infrastructure.

This argument is endorsed by Swarts and Wachira (2009), who discovered in a situation analysis of ICT education in Kenya that "most secondary schools in Kenya have some computer facilities" according to the 2006 National ICT Education Strategy, but "only a tiny percentage are fitted with fundamental ICT facilities" needed for teaching and learning.

Bush and Jackson (20012), however, vary from the results above, arguing that the significant cause of ineffectiveness in e-learning is the theories of instructional practice embraced by classroom management, mostly transferred from America. The investigator notes that, owing to domestic and cultural variations, the theories pose difficulties in implementation

Teacher Competence on e-Learning

Tilya (2007) notes that qualified man-power is very important for the application of any technology. Hennessy et al. (2010) discovered that educators and trainers in many secondary schools who are required to provide e-learning lack the ability to implement e-learning and thus adopt an attitude of hostility towards ICT learning.

ICT Support Staff

Previous assessment of the ICT education scenario in Kenya disclosed that absence of or inexperienced support employees is one of the variables that hamper efficient e-learning in secondary schools. The results estimated that 60% of ICT infrastructure was not used in schools

due to absence of maintenance that included repairs, upgrades, diagnosis and other preventive measures (Swarts and Wachira, 2009).

However, Hennessy et al. (2010) claims that the challenge lies within the curriculum, even with the availability of qualified ICT support employees, in the absence of contextually suitable course material and adverse attitudes among school officials towards computers and the Internet.

ICT Policies

According to McCarthy and Berger (2008), the ICT policy of a school significantly influences the capacity of learners to adapt to e-learning.

These findings require extensive measures to enhance ICT in education to enable schools to be better equipped to react to innovation problems.

However, although the Kenyan government implemented ICT education in Kenya's secondary schools through its 2005 session paper No.1, the lack of accurate, quality information, in relation to the lack of uniform rules for creating appropriate and similar indicators, is hindering policymakers in making informed choices or showing higher dedication to incorporating ICT into the education system.(Swarts and Wachira, 2009).

Costs of e-Learning Equipment

Okuongo (2006) and Wangari (2008) note that, in addition to teachers ' ICT literacy status, school ICT policy and school hardware accessibility, the elevated price of e-learning facilities remains a significant impediment to the efficacy of e-learning in Kenya's secondary schools. Wafula and Wanyonyi (2007) discovered that while the government, realizing the significance of ICT in schooling, encouraged private industries to help promote ICT in schools, Bonyo (2008) emphasizes that the primary reason provided for school non-connectivity was cost. Most of Kenya's colleges have no electricity, and internet costs are very high.

Although the authenticity of the study outcomes above is difficult to identify owing to the absence of clear research methodology, the present research recognizes that these studies provide significant insights into the variables influencing e-learning efficiency in Kenya. This research, however, aims to go beyond defining the factors influencing e-learning in order to provide alternatives to how the price issue can be resolved in order to improve the same

2.6 Current State Of Affairs

The existence of ICT facilities in a college is a sign of an enabling e-learning setting. It implies e-learning can only be done when ICT infrastructure is in place (Ayere, Odera & Ogak, 2012)

In Kenyan Secondary Schools, attempts have been made to introduce e-learning platforms. Efforts to digitize the curriculum go hand in hand with Elimika, KIE's open platform e-learning tool that targets to enhance ICT proficiency among teachers.

a-ACADEMY

A-ACADEMY is another creative platform that contributes to this growth.

It is interactive learning software that educators can use as a teaching instrument or as an engaging self-study instrument at home by students.

Its digital curriculum includes thousands of interesting and extremely interactive learning operations, organized pedagogically into topics, norms and units.

The extensive material is aligned with the Kenyan curriculum, and the Kenya Institute for Curriculum Development has formally endorsed it.

In close collaboration between African educators, international curriculum editors, and instructional designers, the content was developed.

Kytabu

Kytabu aims to enhance access for all students to quality schooling. Learning materials, especially textbooks, stay a basic resource for learners, but obstacles such as affordability, availability and comfort are prevalent, especially for students in marginalized household.

The Kytabu textbook app enables learners who do not have the financial capital to buy all necessary textbooks in Kenyan schools to buy them as digital copies for less than half of the hard copy cost.

Shupavu 291

Eneza Education, launched in 2012, utilizes low-cost mobile technology to provide users with instructional courses and assessments using SMS, internet and Android platforms.

Shupavu 291, which in conjunction with Safaricom is now available in 400 schools across Kenya, can be accessed from any mobile phone by dialing* 291 #or sending the word "START" to 20851.

It allows learners to study quizzes, search subjects and themes, and access summaries of Wikipedia without having to connect to the internet. Teachers and parents can inspect reports on individual student performance and performance of the college through SMS with the service.

The service also involves the function "ASK-A-TEACHER," which allows learners to ask a live teacher questions remotely.

Moringa School

Moringa School is a Nairobi-based intensive tech education program providing a 5-week preparation and 5-month course. Moringa School is a world-class accelerator for coding with a direct job model education. The focus is on enabling a whole generation of high-potential, proactive, technology-loving young individuals.

2.7 Research Gap

According to (Rana, Rajiv, & Lal, 2014), despite the constant introduction of these platforms, there is a gap in the following aspects;

Convergence and interoperability

Exploring various types of convergence (organisational, technological, educational, sectoral, institutional, etc.). How well do they know globalization problems and norms of scalability to promote interoperability?

Interactivity and social interaction

How does the interactivity of various tools relate or affect the medium's nature? How is interactivity expressed at different organizational levels and how are organizational boundaries and functional groupings blurred as a result of new technologies? What potential do new technologies need to improve communication and collaboration and also create new communities and networks?

Rana, Rajiv, & Lal points out in their study recommendation that e-learning research has given the highest priority to learning content and learning communities. Lots of development must be made in these areas.

As technology grows day by day, the interest of learners in e-learning is increasing quickly. Researcher has now started to work on developing new methodologies of e-learning that can operate according to the concern and preference of the learners.

They have to study learner conduct, learning style through their internet operations, and search criteria to predict learner interest.

2.8 THEORETICAL FRAMEWORK

2.8.1 Elaboration Theory

The paradigm shift from teacher-centric instruction to learner-centric instruction has caused "new sequence instruction needs." Charles Reigeluth has put forward Elaboration Theory, an educational design model that seeks to assist pick and sequence material in a manner that optimizes learning goals achievement.

Supporters feel that using motivators, analogies, summaries and syntheses results in efficient teaching. Although the theory is not mainly concerned with affective material, it is designed for medium to complicated types of cognitive and psychomotor learning Elaboration Theory (Reigeluth)

Elaboration theory is an educational design theory that claims that learning material should be structured from simple to complicated order, while creating a significant context in which subsequent concepts can be incorporated.

2.8.2 Component Display theory (CDT)

The Component Display Theory (CDT) by David Merrill is based mainly on the same assumptions as the Events of Instruction by Robert Gagne. Both agree that distinct learning kinds require distinct kinds of teaching processes as well as distinct means of evaluation. The component display theory, however, focuses mainly on learning individual ideas and arranges training to provide control to the learner.

The theory of the component display is design strategy for instruction design. At one time, it focuses on a single idea or goal. It is mostly used after conducting a task analysis (Anglin, 1995). The theory of the component display provides a list of prescriptions for designing instructions for various types of instructional results.

The theory indicates that training is more efficient in so far as it includes all the main and secondary types that are essential. Thus, a full lesson would consist of goal followed by a mixture of guidelines, examples, recall, practice, feedback, assistance and mnemonics suitable for the topic and learning assignment.

Indeed, the theory suggests that there is a unique combination of presentation forms for a given objective and learner, resulting in the most effective learning experience

There are two components of the component display theory: content and performance. The dimension of content consists of facts, ideas, processes and values. The performance dimension consists of recollection, use, discovery and generalities

The relevance of component display theory to the research is that it provides the learners / students with the best possible guidelines and methods for delivering e-learning content.

2.8.3 Technology–Organization–Environment (TOE) framework

The TOE framework was founded by Tornatzky and Fleisher (1990). It illustrates aspects that affect the acceptance and probability of technology. Technology–Organization–Environment (TOE) defines the process by which a business adopts and implements technological innovations depending on the framework of technology, the organizational context and the environment (Tornatzky and Fleisher 1990).

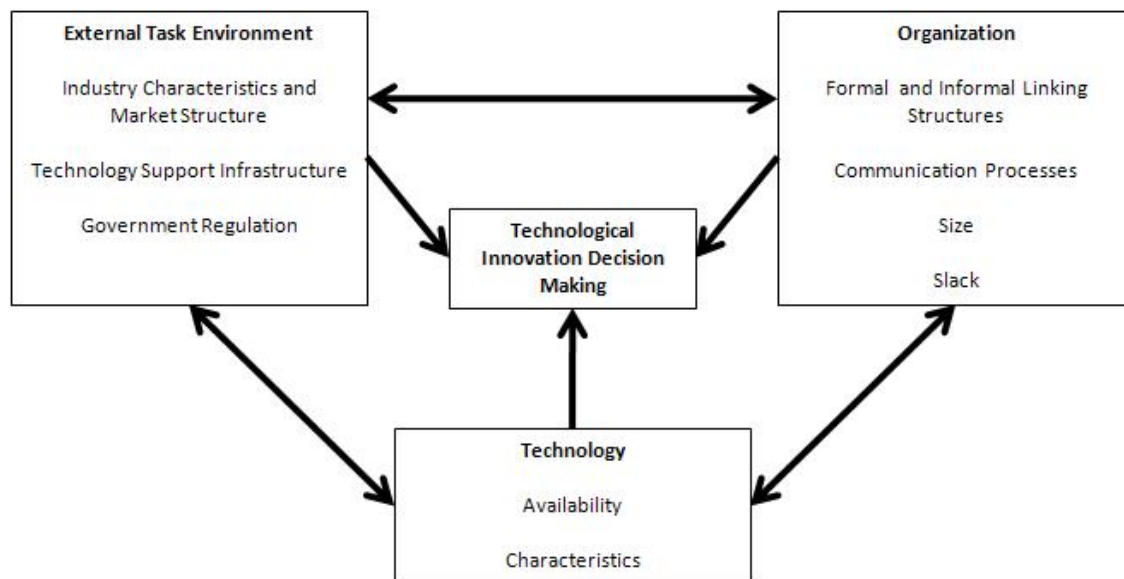


Figure 4: Technology–Organization–Environment (TOE) framework

The technological context - involves the inner and external techniques used in the construction and implementation of prototypes. Technologies can include both machinery and procedures. In my prototype the researcher included mobile applications, interactivity, offline data, stand-alone desktop, multi-platform, etc.

2.9 CONCEPTUAL FRAMEWORK

The biggest goal of the conceptual framework was to connect to each other the key axioms of the theories in order to investigate goals and hypotheses of the research. This was accomplished by showing by use of diagrams, the interplay across variables (dependent as well as independent) which are highlighted in the theoretical frameworks

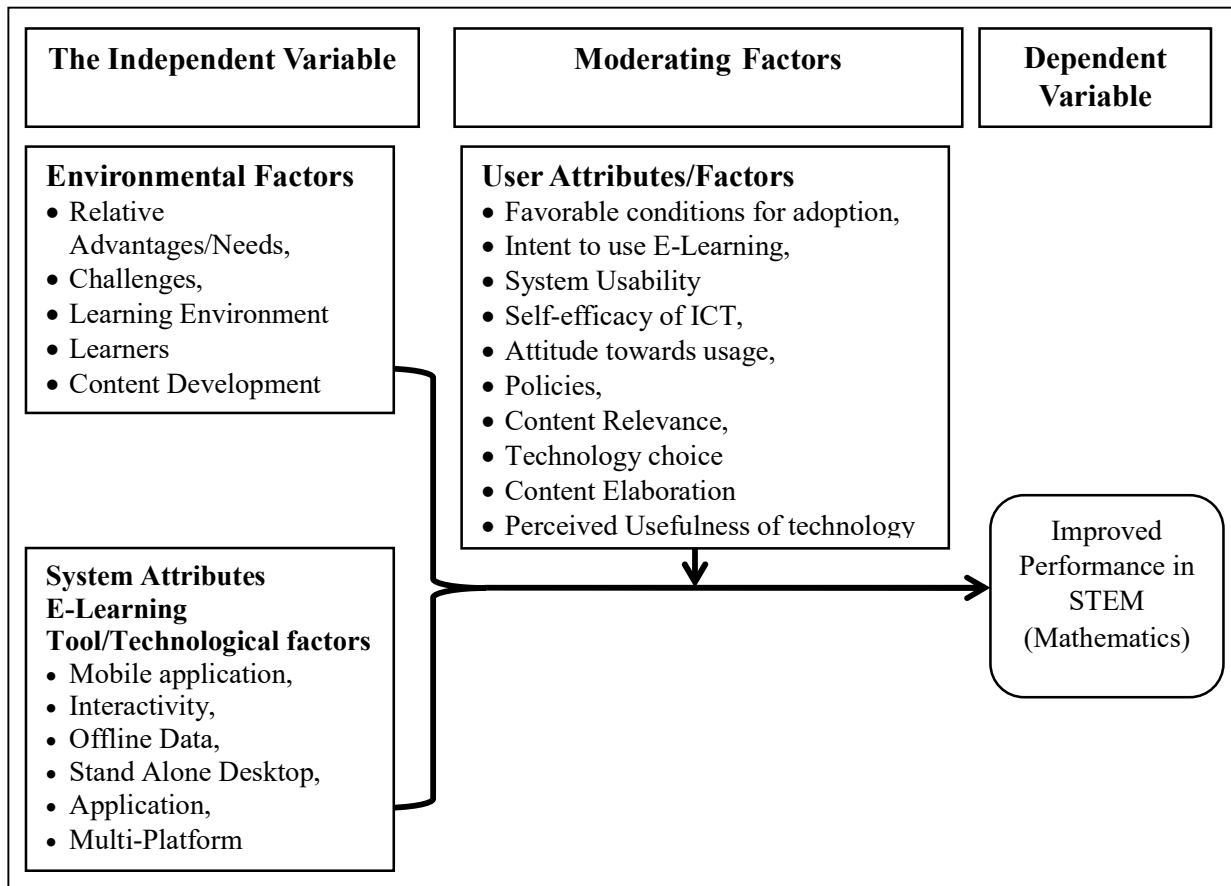


Figure 5: Conceptual Framework

The Conceptual framework indicates that the research has been assimilated within the above conceptual framework, by identifying two independent variables: system attributes of the e-learning tool and environmental factors. The independent variables are mediated by user factors conditions, e.g Intent to use E-Learning, System Usability, Self-efficacy of ICT, Attitude towards usage, Policies, Content Relevance, Policies, Content relevance, Content elaboration, Perceived Usefulness of technology and choice of Technology.

If these variables are favorable, this will result in adoption and optimal utilization of the e-Learning tool and by so doing change or improve performance on Mathematics which is the sampled STEM subject.

2.9.1 Conceptual Framework Relevance

The conceptual framework's primary objective was to investigate the interaction of the identified variables in order to unravel the factors that would make e-learning a success story for young women in secondary schools.

The conceptual framework will also identify e-Learning environmental and user attributes.

If the proposed prototype has the indicated attributes, with a favorable medication, implementation would be a success and the objective of the research would be achieved.

2.10 Prototype Architectural Design

It should be evident from the preceding discussion that cultivating enduring, meaningful, and transferable knowledge requires a holistic instructional design approach incorporating all of the discussed approaches (for two attempts to do this, see Merrienboer & Kester, 2005; Merrill, 2002). Furthermore, the effectiveness of any particular instructional method is highly context sensitive, a function of learner prior knowledge, desired learning outcomes, and content complexity. Designing successful online and blended learning experiences requires continually balancing instructional support and explanation with learner activity and knowledge construction (Wittwer & Renkl, 2010). Highlighted below is an illustration of an instructional architecture discussed.

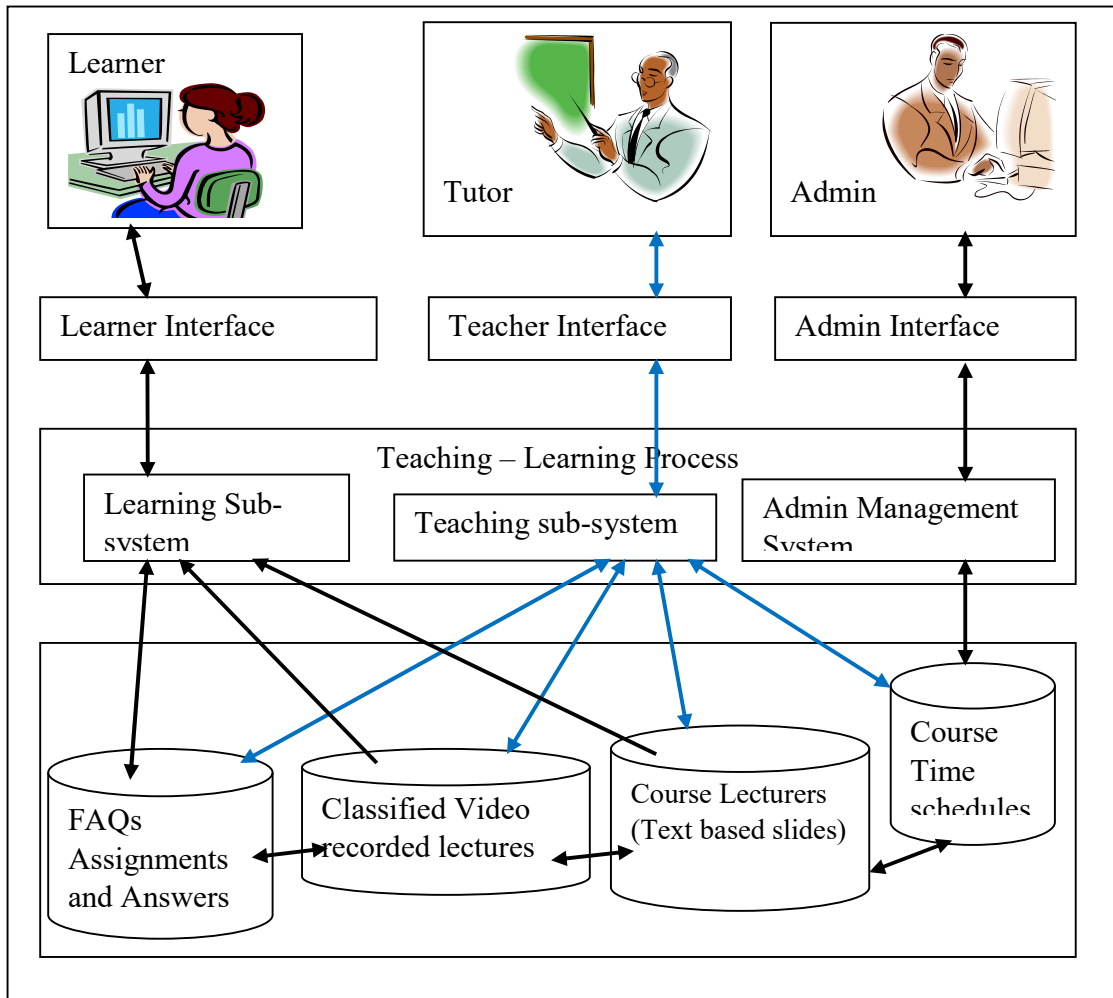


Figure 6: Prototype architectural design

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

This is a systematic way of solving a research problem. Essentially, the procedures of which researchers describes, explain and predict phenomena of their work. It defines the combination of strategies and methods adopted in the study (Kothari, 2004; Rajasekar et al., 2013).

System development as described by the association of modern technologies professionals, is a framework used to structure, plan and control the process of developing information systems. There are several system development methodologies for software design and development. In this research project iterative and incremental development methodology was adapted.

3.1 RESEARCH DESIGN

A research design is a systematic technique used by a scientist to conduct a science study. It is the overall synchronization of acknowledged components and data, leading to a plausible outcome. The research design should follow a strategic methodology that is consistent with the type of study chosen to achieve an authentic and accurate result.

3.2 Research Philosophy

Pragmatism

This research was based on the pragmatism philosophy because it can incorporate more than one research methods and research policies within the same study unlike positivism and interpretivism research philosophies.

The pragmatic strategy includes using the method that seems ideally suited to the research problem.

3.3 Research approach

This research was based on a deductive approach as it concerned the development of hypotheses (or hypotheses) based on existing theory and then the development of a research strategy to test the hypothesis.

3.4 Methodological Choice

This research employed the Mixed-methods research methodology (Triangulation). The researcher used the concurrent triangulation strategy where the qualitative and quantitative phases were conducted simultaneously because of time concern. Each stage was provided ideally equal weight, with the outcomes of both being simultaneously interpreted to determine if there is consensus in the information gathered through each strategy.

3.5 Research Strategy

Quasi Experiment – This research employed a Quasi experimental strategy. The researcher manipulated the some variables and measured the results thereafter. The variables manipulated included the introduction of e-learning alongside the conventional teaching method and later tested the student’s performance after a specific period of learning. Further, this research focused on a case for a particular school, (Kariobangi North Girls Secondary School) as the research population.

The researcher chose this particular school because of several reasons. The school is located at Kariobangi North, a suburb that is mainly for lower-middle to lower class residents. This means that the poverty index is relatively lower than most of the regions.

This therefore provides a better opportunity and avenue increasing the value of this research in that its contribution affects directly to development.

The school is all-girls that therefore the research population was quite convenient.

3.6 Requirements Gathering

The research was aiming into understanding the current teaching and course delivery process in order to propose and build a suitable e-Learning prototype that was to help in improving the girl’s performance. For such requirement to be attained the research used several data collection techniques.

The research used closed and open questionnaires to Kariobangi Girls secondary school pupils and teachers.

The research also used structured interviews to the Head teacher and the librarian.

3.7 Requirement analysis

The purpose of requirement analysis was to understand the business processes, environment and ensuring required measures was incorporated and considerable in the design and development of the prototype.

3.7.1 Analysis Phase

The analytical stage describes the system requirements, regardless of how these specifications are to be fulfilled. This stage describes the issue to be solved by the client. A requirement document is the deliverable outcome at the end of this stage. Ideally, this document sets out what to build in a clear and accurate way.

3.7.2 Population and Sample size

Population is defined as the entire group of individuals, events or objects having a common observable characteristic (Mugenda & Mugenda, 2003). In this research a population was chosen as Kariobangi North Girls secondary school.

Sample size is described as the number of items to be selected from the universe to constitute a sample (Kothari, 2004).

In this study a sample size was chosen which students through simple random sampling, and the finding was generalized to whole population. Purposive sampling method was used for selecting the teachers. The selection of teachers was through purposive sampling since they provided valuable information that met the purpose of the research.

To attain the sample size, the research used the following formulas as adapted from Kothari and Mugenda

$$\frac{\frac{Z^2 \cdot p(1-p)}{e^2}}{1 + \left(\frac{Z^2 \cdot p(1-p)}{e^2 N}\right)}$$

Thus necessary sample size $n = (1.96^2) \times (0.5 \times (1-0.5))/(0.05^2) = 384.14$,

$nf = (385 / (1 + (385/45))) = 40.2$, 40 (a class of 45 students was used with a sample size of 40)

This was number of persons the research was used on requirements gathering.

3.8 PRE STUDY DATA ANALYSIS

3.8.1 Questionnaire Analysis

These were the views and input collected from the stakeholders such as students from one class and their teacher.

3.8.1.1 Analysis for Student Respondents

The students were key participants in this research, they were the main category of people responsible in various duties within the sector, and their participations provided important information regarding this research, below are finding from some of participants conducted through use of closed and open questionnaire;

Demographics

On the Gender Question, 100% of the participants were Female

What is your Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Female	40	100.0	100.0	100.0

Figure 7: Gender Table

The sample population was picked from Form two level of study. Therefore 100% of the respondents chose the option Form One

Level of Secondary Education

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Form One	40	100.0	100.0	100.0

Figure 8: Level of study Chart

Out of the sampled population, 32 (80%) of the respondents were computer literate. Computer literacy is the foundation and enabling factor to utilization and adoption of computing products. Further computer classes are mandatory for all. Therefore it was important that majority of the sampled population were computer literate as shown on the chart below.

Computer Literacy

Do you know how to use a computer

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	8	20.0	20.0	20.0
Yes	32	80.0	80.0	100.0
Total	40	100.0	100.0	

Figure 9: computer usage skills

36 (90%) of the respondents sampled and interviewed indicated that they know to use a smart phone. This indicator was important because this was the ICT tool that delivered the application for use.

Smartphone usage skills

Do you know how to use a Smart Phone

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	4	10.0	10.0	10.0
Yes	36	90.0	90.0	100.0
Total	40	100.0	100.0	

Figure 10: Smart phone usage skills

Internet skills was an important variable in the research since some of the functionalities of the e-Learning prototype are online. Out of the 40 respondents 30 (75%) of them indicated that they have internet usage skills.

Internet Usage skills

Do you know how to use the internet?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	10	25.0	25.0	25.0
Yes	30	75.0	75.0	100.0
Total	40	100.0	100.0	

Figure 11: Internet usage skills

Out of the sampled population 52% of them have access to internet at home. This is more than a half of the sampled population. This indicator therefore means that the prototype was had to be designed in a way that it's not entirely dependent on an internet connection.

Access to Internet

The Prototype only required an internet connection once and thereafter it would be usable offline. This therefore eased the burden of the need to purchase internet bundles every time the students wanted to access the application.

Do you have access to internet while at home?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	19	47.5	47.5	47.5
Yes	21	52.5	52.5	100.0
Total	40	100.0	100.0	

Figure 12: Internet accessibility

Computer Access

Out of the respondents, only 4 (10%) have access to a computer at home. This indicator was aimed at investigating the possibility of implementing a Desktop application to cater for the group.

Do you have access to a computer at home?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	36	90.0	90.0	90.0
Yes	4	10.0	10.0	100.0
Total	40	100.0	100.0	

Figure 13: Computer accessibility

Smartphone Access

On the question of if the respondents have access to a smart phone, 89.7% of them have access as shown in the chart. A smart phone was the tool that they used to access and use the prototype. This statistic was very important for the research.

Do you have access to a Smartphone at home?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2.5	2.5	2.5
No	4	10.0	10.0	12.5
Yes	35	87.5	87.5	100.0
Total	40	100.0	100.0	

Figure 14: Smartphone accessibility

Previous Performance in Mathematics

Mathematics was used as the STEM subject for the study. I wanted to determine the student's previous performance by asking the question below. By so doing I would gauge the current state of affairs and at the same time use the performance as a historical control or comparison.

9. How was your performance in Mathematics in the last term examinations? 📄

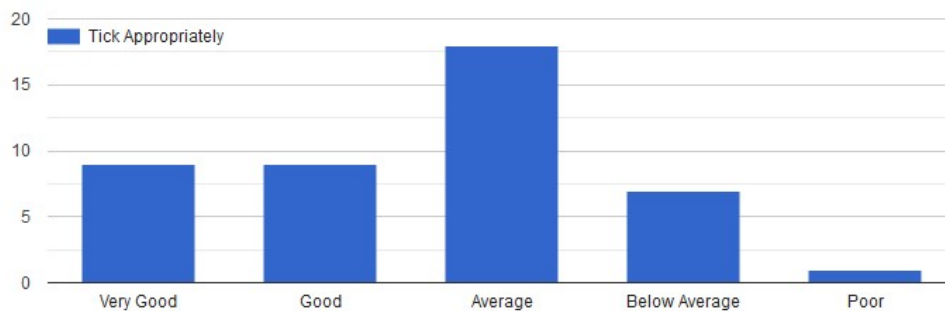


Figure 15: Performance index of subject

Levels of Perceived ease of Mathematics subject

I also tested the sampled population (students) perceptions on the Mathematics subject. Below is a chart of the findings. More than a half (60%) of the respondents believed that it's challenging, while 25% felt it was Manageable, 20% believe it's very challenging and 12.5% believe its Straightforward.

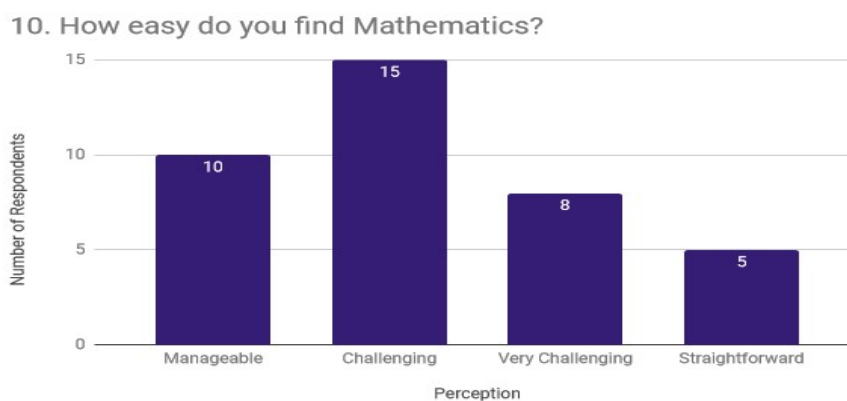


Figure 16: Smartphone accessibility

Challenges in Tackling Mathematics Subject

When the respondents indicated to have challenges when tackling Mathematics, I followed up to determine what some of these challenges could be attributed to. The feedback strongly agreed that among the attributing factors include;

- Lack of Enough Self study
- Lack of Appropriate revision Materials
- Limited time in teacher to student interaction

The Breakdown is shown in the graph below.

11. To what extent do you agree with the following possible reasons regarding challenges in Mathematics subject?

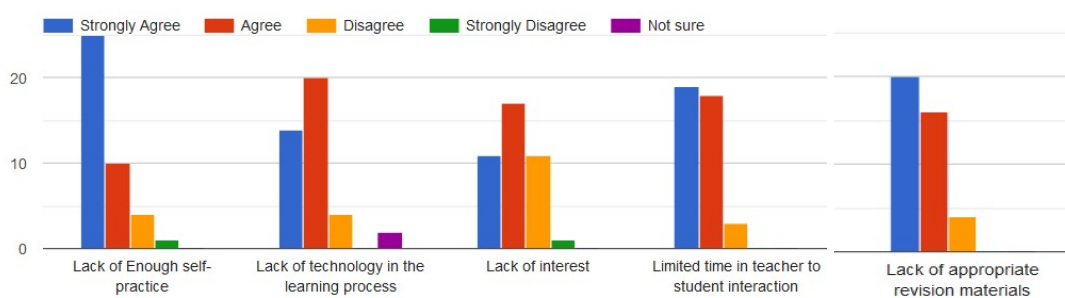


Figure 17: Smartphone accessibility

Class Attendance

During the prescribed lesson time, not all students are present. As shown in the graph a good number of students indicated that they are not always present for classes. This could be accosioned by the fact that this is a day school and absenteeism would be higher compared to a boarding school.

Are you always present during the lessons?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	7	17.5	17.5	17.5
Yes	33	82.5	82.5	100.0
Total	40	100.0	100.0	

Figure 18: Class attendance

Access to Textbooks

Textbooks are critical inputs that affect the learning of students. Textbooks are more likely to enhance student learning when they are based on a curriculum, when they use an easily understood language at a suitable level for learners and educators, and when educators adapt their pedagogy to make efficient use of it. In my research I sought to know the percentage of respondents with all the required textbooks and the graph below illustrates the outcome. Out of the 40 respondents only 12.5% indicated to have all the required textbooks.

Do you have all the required Text books for Mathematics?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	35	87.5	87.5	87.5
Yes	5	12.5	12.5	100.0
Total	40	100.0	100.0	

Figure 19: Text Book Availability

This could be occasioned by the fact this school is located within a region with a relatively low lifestyle index. Therefore the need for innovative ways to help the less privileged

Knowledge on e-learning

e-Learning concepts are not familiar with everybody and especially students at this level of education thus it would have been wrong to assume that they have the knowledge. Therefore it was important to test their level of understanding on the same. I did this by asking if they had some knowledge on learning, and if yes how would they rate. The table below gives an illustration on how they responded. 77% of the sample population said Yes, they have some knowledge on e-Learning while 22.5% indicating Not Knowledgeable

19. Do you have some knowledge on E-learning?

40 responses

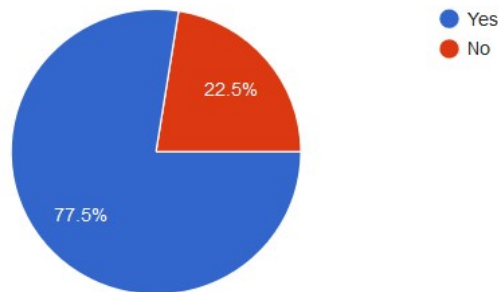


Figure 20: Knowledge on e-Learning

Solution prototype recommendation

In order to find a suitable solution to the research problem and given outcome of the pre-study, I proposed an e-Learning prototype to the sampled population. When doing this I sought to know how important they perceived it would be of help to them. And the chart before gives an illustration of the feedback. 22 of the respondents felt that it would be Very Helpful, 15 felt that it would be Helpful, while 4 felt it would be of little help to not helpful at all.

Suppose an E-Learning system is to be introduced to assist you in your self-study while not in school, how helpful would it be

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18	31.0	31.0	31.0
Helpful	15	25.9	25.9	56.9
Little help	1	1.7	1.7	58.6
Not helpful	2	3.4	3.4	62.1
Very helpful	22	37.9	37.9	100.0
Total	58	100.0	100.0	

Figure 21: Prototype Recommendation

E-Learning applications come in different technologies to deliver content to users. These technologies suit different types of users and environments. Therefore is sought to know which technology the sampled population felt that would be ideal if it was to be implemented.

The graph below illustrates the feedback. 67.5% felt that a Mobile application would be ideal, 27.5% chose Web application while 5% chose Desktop application.

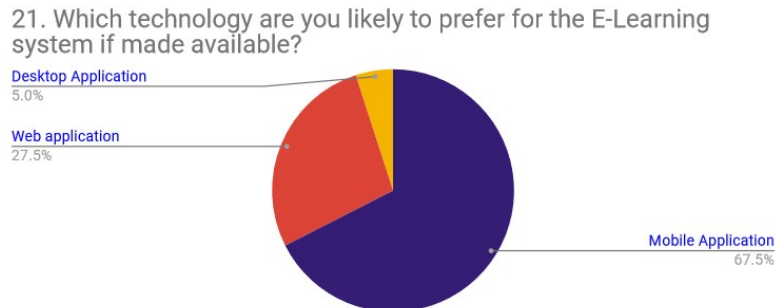


Figure 22: Technology Approach

Perceived importance of the solution

Finally, as to whether the adoption of proposed solution would have an impact on the current state of affair and help the students improve their performance in Mathematics, which is the main goal of this research, I sought to know from the respondents expectations. The chart below illustrates the feedback analysis. 62% of the sample population expected that it would be Very Helpful, 30% expected it would be helpful while 8% felt that it would be of little help to no help at all.

22. Suppose a suitable E-Learning system is to be used to assist you in your self-study while not in school, how would it be of help in improving your performance in Mathematics?
40 responses

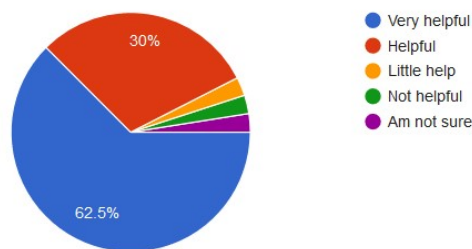


Figure 23: Perceived Importance of the prototype

3.8.1.2 Analysis for Teacher Respondent

In my pre-study, I also interviewed three (3) Mathematics teachers teaching form one. The following is the analysis of the questionnaire feedback. Out of the three, two were between the age of 18-34 years while One was between 35-49 years.

Efficiency of the conventional methods of teaching

I sought to know the teacher’s experience with the current system of teaching. All three anonymously agreed that there is opportunity for improvement and support. The feedback is as shown below.

What is your experience with the conventional teacher to student method of teaching?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Could be Enhanced	3	100.0	100.0	100.0

Figure 24: Efficiency of the conventional methods of teaching

Performance in Mathematics Subject

And to get a picture of the impact of the current system without support of E-Learning I sought to know what was the student’s performance on the Mathematics subject in the previous term for the same class. The respondents said it was average.

7. How was the performance of your students in Mathematics in last term’s examination?

3 responses



Figure 25: Performance in Mathematics Subject

Teacher knowledge on e-learning

It was important to determine the level of preparedness by the Mathematics teachers. To do this I sought to know their knowledge, awareness and experience on e-Learning tools. All the three teachers had some knowledge.

The teachers also indicated to have interacted with some E-Learning platforms.

20. Have you interacted with an E-Learning platform/system before?

3 responses

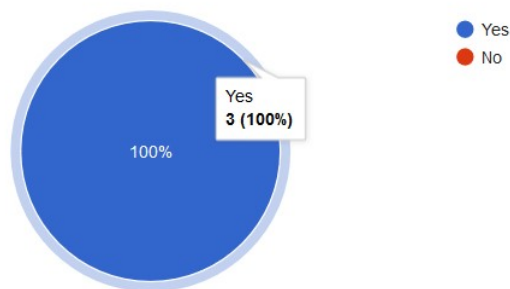


Figure 26: Teacher knowledge on e-learning

Technology as an opportunity

Teachers opinion on if technology adoption can have an impact on Mathematics performance is as illustrated below. Two of the teachers were optimistic while one wasn't very sure.

Do you think technology can be used to enhance teaching of mathematics in high school?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Maybe	2	66.7	66.7	66.7
Yes	1	33.3	33.3	100.0
Total	3	100.0	100.0	

Figure 27: Technology as an opportunity

Subject Teacher's Expectations

I sought to know the teacher's expectations on adoption of technology and specifically an E-Learning solution. All the three teachers indicated that it would be a helpful solution.

Suppose an E-Learning platform is to be used to assist your students in self-study while not in school, how helpful would it be?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Helpful	3	100.0	100.0	100.0

Figure 28: Teacher's Expectations

Choice of Technology

On the suitable choice of Technology implementation approach, majority of the teachers showed preference on a Mobile application.

Teacher's perceived importance of the prototype

What impact according the teachers opinion would the successful implementation of the solution have on the performance of the students in mathematics?

24. In to your opinion, do you believe the introduction and adoption or the E-Learning tool would have an impact on the performance of your students in Mathematics

3 responses

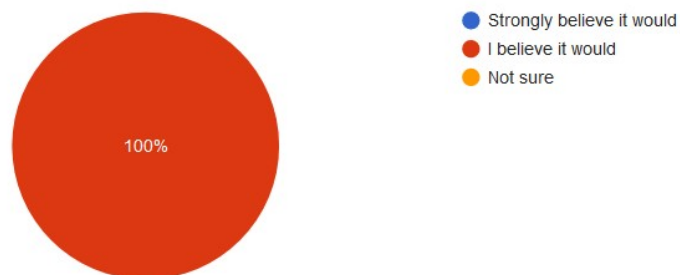


Figure 29: Teacher's perceived importance of the prototype

3.8.1.3 Interview Response Synthesis

From the interview checklist i was able to gather that:

1. The sample population undertakes computer as per the curriculum
2. The computer studies teacher is experienced and competent
3. The school has sufficient ICT infrastructure
4. The students have recorded a good performance in last term's examinations
5. Therefore in the teachers' expert opinion, the sampled population (Form 1 Red) is ICT literate and technology ready to adopt and utilize an e-Learning system.

3.9 SYSTEM DEVELOPMENT METHODOLOGY

3.9.1 Rational Unified Process

Rational Unified Process (RUP) is an IBM division, software development method. It splits the process of growth into four separate stages, each involving company modeling, analysis and design, execution, testing, and deployment.

The phases in the Rational Unified Process:

Inception - The objective of the inception is to set up a business case for the scheme. The researcher recognized and defined all internal entities (individuals and structures) that communicate with the scheme. The researcher then used this data to evaluate the company's contribution to the scheme. If this input were minor, then after this stage the project would have been cancelled.

Elaboration - The objective of the elaboration stage was to create a comprehension of the issue domain, create a system architectural structure, create the project plan and identify main project risks. Upon completion of this stage, the researcher had a system requirement model that could be a collection of UML use cases, an architectural description, and a software development plan.

Construction - The stage of construction engaged the design, programming and testing of the scheme. During this stage parallel parts of the scheme were created and incorporated. The researcher had a working software system and related paperwork ready for delivery to customers at the end of this stage.

Transition – This is the last stage of the process and it involves rolling out the system of development to the users. In most software process models, this is something that is ignored but is, in reality, a costly and sometimes difficult activity.

3.9.1.1 Feasibility study

This summarizes the feasibility of this project, It entails the initials investigations and analysis after the construction of the system.

Feasibility	What to investigated	Study outcome
Operational	Will the system be effective after it has been developed and deployed? Will the system meet the intended expectation and functionality?	It was found the system worked after deployment System was evaluated by users, meets intended functionality
Technical	The technical resources needed for development, purchasing, installation and operating the proposed system Available technology and infrastructures for development implementations of the proposed system	The high growth of mobile penetration networks and ownership of mobile phones in Kenya
Economic	Will the projected benefits of the proposed system outweigh predictable expenses?	The system's benefits vastly outweigh the costs as it helps many stakeholders in solve their problems
Schedule	Will the project carried out in an acceptable time frame? Was time allocated to the project reasonable and adequate?	The research was carried out in a set of three milestones and deadlines was adhered to A project schedule was prepared and time allocation was enough for completion.
Political	How the existing system structure going to work with new system? Will the users and stakeholders accept the proposed system?	The existing system structure worked with system after deployment. The system would help in improving the student's performance in Mathematics subject All stakeholders used and accepted the system as per requirement analysis
Legal	Will proposed system implemented within existing legal requirements?	The research adhered to constitution and county government act of Kenya The research ensured confidentiality of information gathered, privacy of personal information and rights of participants was well protected throughout the research

Figure 30: Feasibility study checklist

3.9.1.2 Design Specifications

It was actualized by the following important two elements specification (Johnstone, 2005)

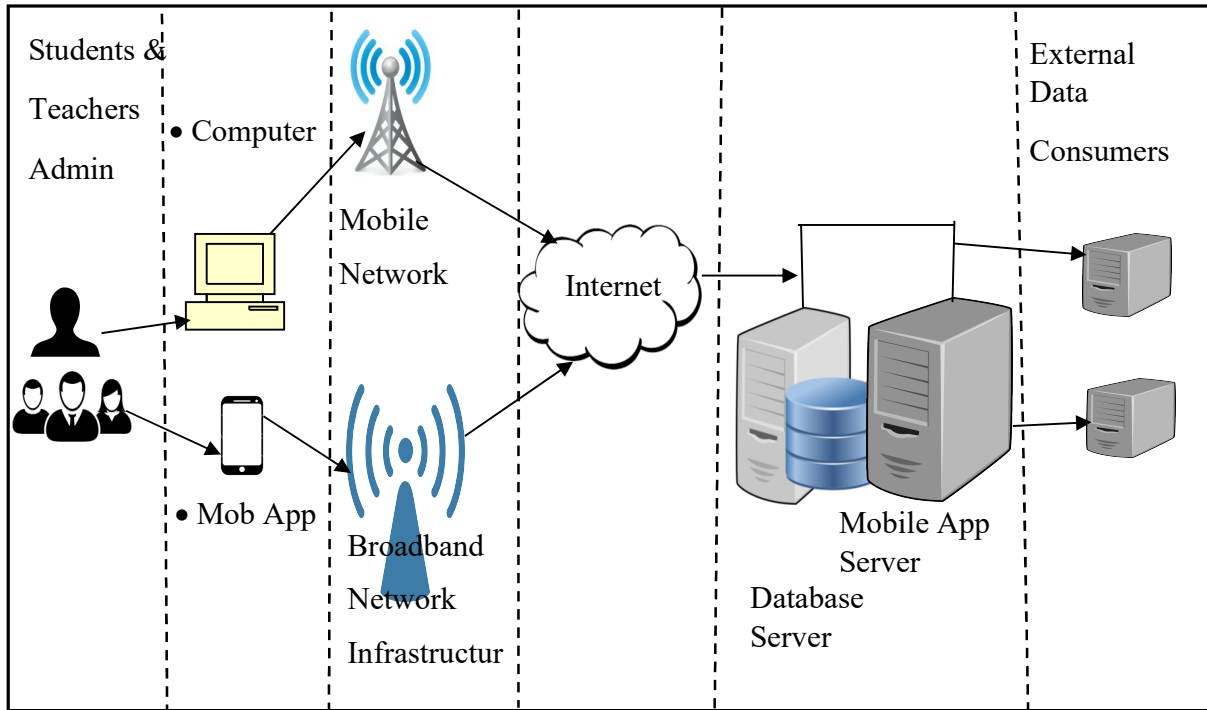


Figure 31: Design Specifications

3.9.1.3 System design diagrams

Flowcharts

The following were flowcharts of different actors in this project. They show the processes of each user.

Student User: A student user registers and on successful registration, they are able to log in and access learning materials.

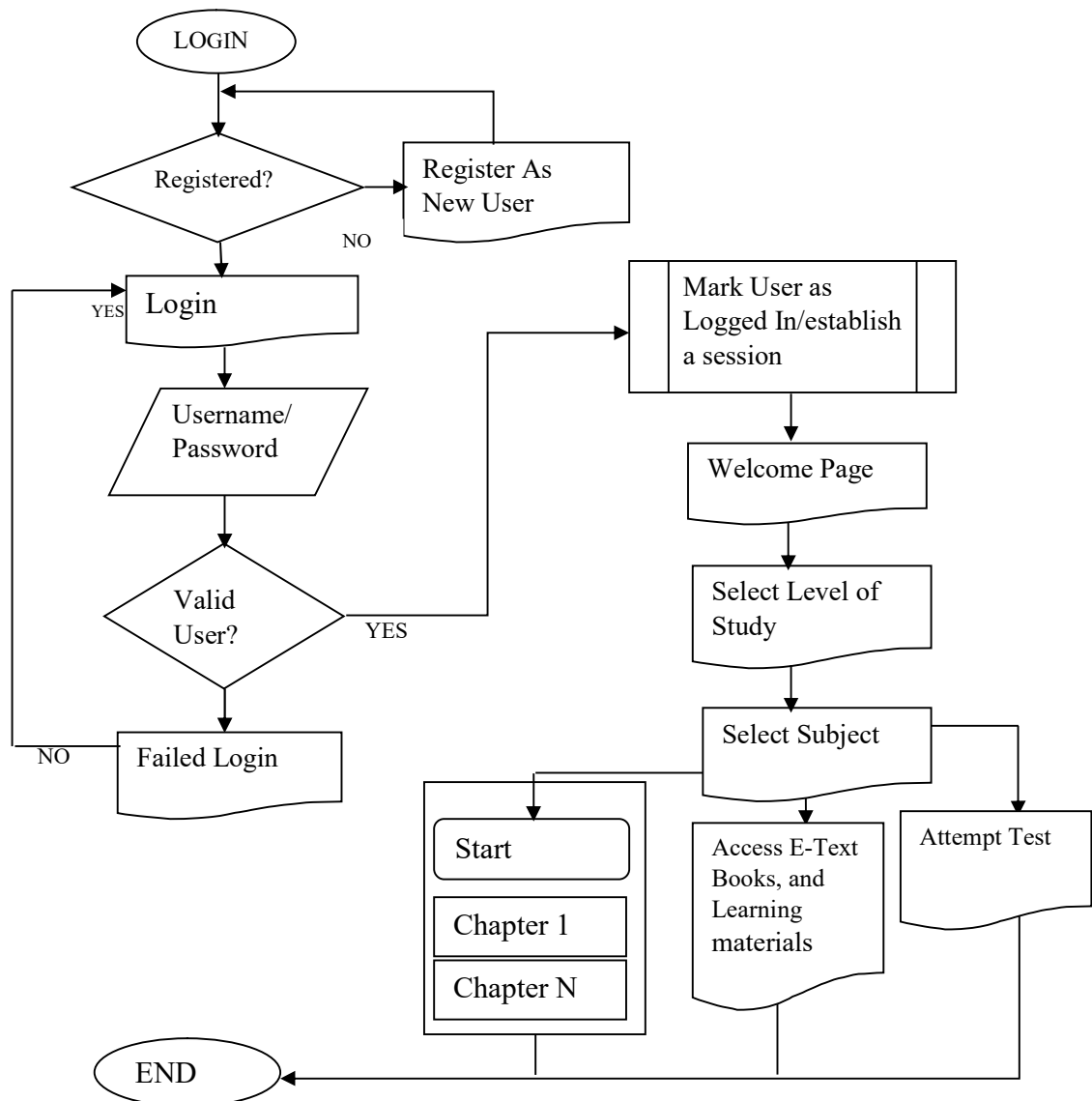


Figure 32: System design diagrams (Student User)

Teacher User

The teachers interact with the system using their own accounts which must have been registered and activated by the administrator. When log in is successful, the teacher can perform a number of activities e.g. Uploading teaching content, setting questions as well as issuing tests. Once the teacher completes these activities he/she may log out to exit the system.

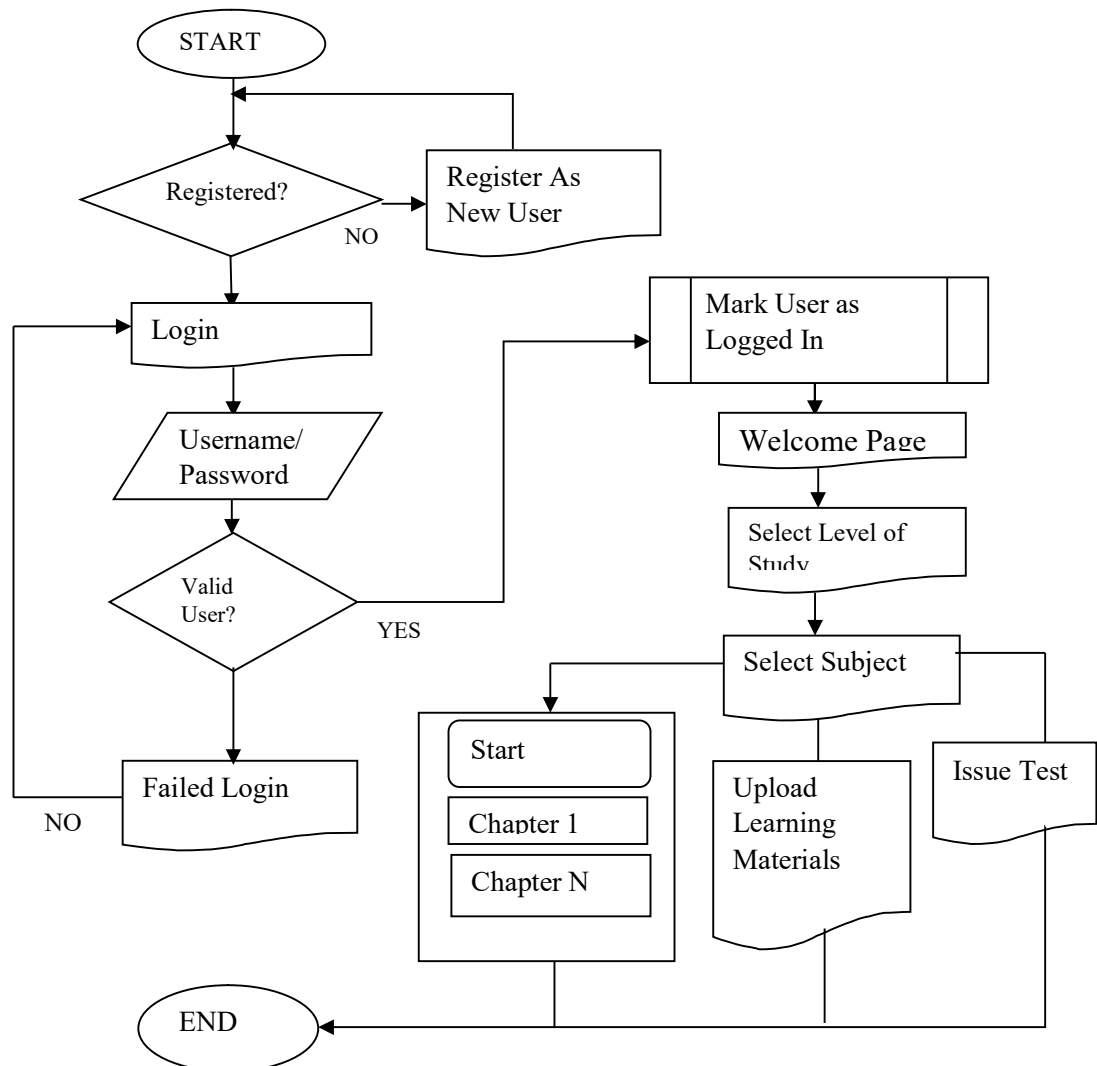


Figure 33: System design diagrams (Teacher User)

Use case model

The use case has three main actors; Student user, Teacher user and Administrator user. The student user does most of the activities. All the actors have to Log-in-to and log-out-off the system. The Teacher and student have to register to start using the system.

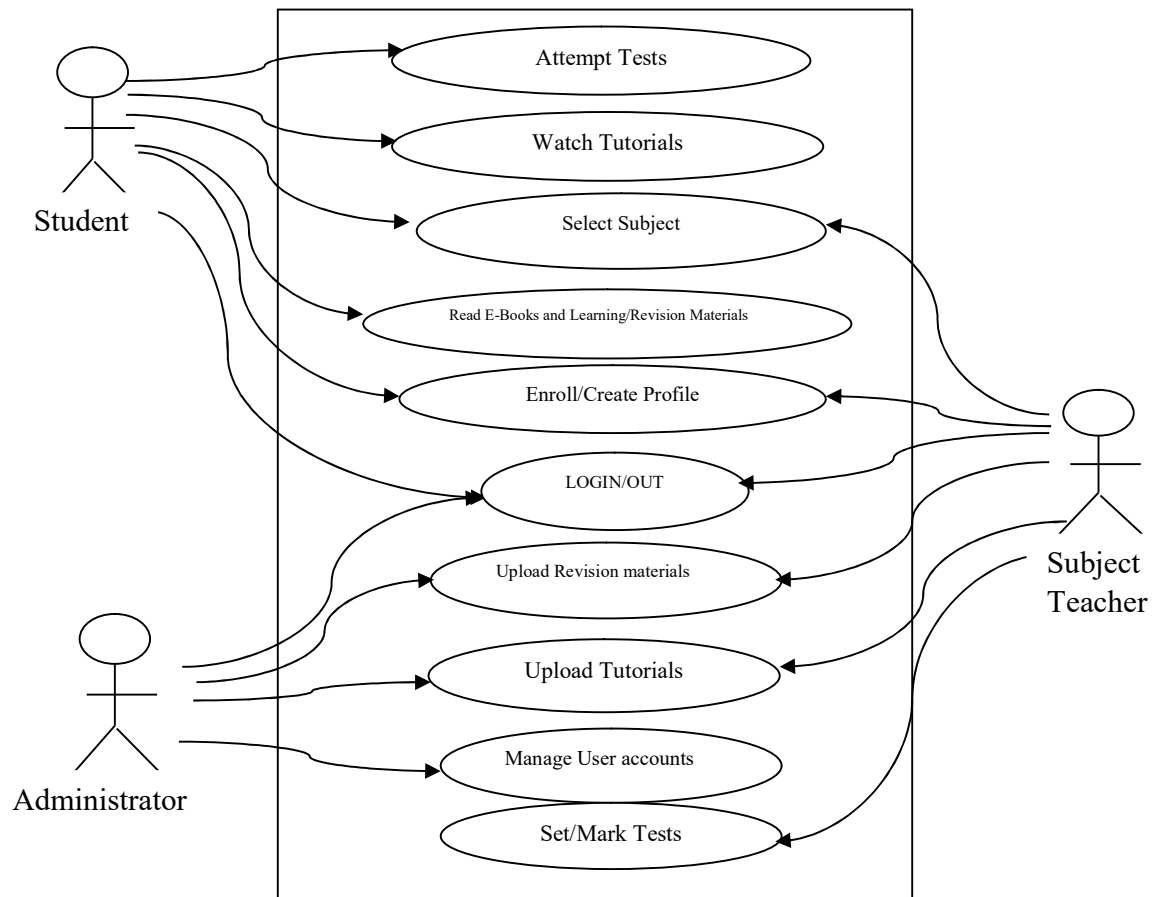


Figure 34: Use case model

System Administrator/Admin: The system administrator will be able to perform the following functions:

- Edit his own profile (credentials and personal details);
- View the list of pending users and approve user registration with tutor or student permission; monitors users and oversees variety of department and course's activities;
- Trains department personnel and students to use the online web application
- Have privileges to activate or deactivate course or user, if and when required;

- Create, edit or delete department structure and add or remove programmes;
- Create, edit or delete course structure and assign learning resources;
- Define course activities (forum, quizzes, chat, assignments, etc);
- Monitors users and oversees variety of department and course's activities;
- Trains department personnel and students to use the online web application.

Subject Teachers: Can perform the following functions:

- Enable manual self-registration and redirection to guest user's dashboard;
- Access tutors' dashboard after admin approves registration;
- View and update his own profile (sign in credentials and personal details);
- View registered student and add or remove one or group of students to the course;
- View students' report and provide remarks;
- Create course and set an unique enrollment key;
- Create, edit or delete course structure and assign learning resources;
- Define course activities (forum, quizzes, chat, assignments, etc);
- Display teaching feedback.

Students: The students are regular student or special student for short term training.

- The student users are permitted to perform following functions:
- Enable manual self-registration and redirection to guest user's dashboard;
- Access students' dashboard after admin approves registration;
- View and update his own profile (sign in credentials and personal details);
- View all the list of courses and their description;
- Subscribe to the courses after entering unique enrollment key and then view course's
- Assigned content resources;
- Participate in discussion forum and chat;
- Test the knowledge of subject through attempting numerous quizzes;
- View grades and remarks from tutor;
- Provide feedbacks to tutor.

Database design

It describes different SQL tables used for this project

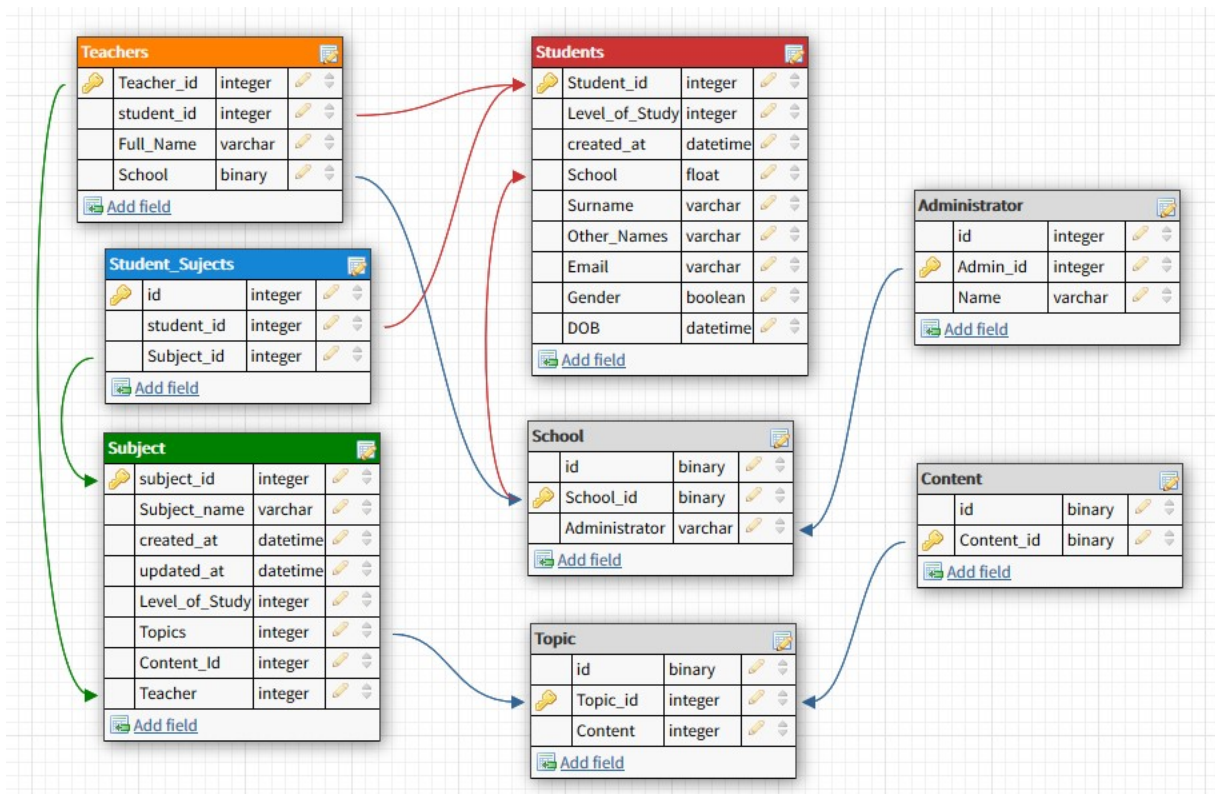


Figure 35: Database design

3.9.2 Construction tools

Hardware Resources

1. Laptop
2. Modems for the SMS gateway
3. Phones (a smartphone and normal phone for testing)

3.9.3 Software Resources

PHP Version 7– This is a server side web programming language that was used for creating web based applications that run on apache server.

JavaScript It is a lightweight web scripting language that can be embedded into HTML. It is used to make websites to be interactive.

Jquery Mobile this is a platform that is used to create mobile applications using CSS 3, HTML 5 and JavaScript. It creates light weight and responsive mobile based application that can run on various platforms.

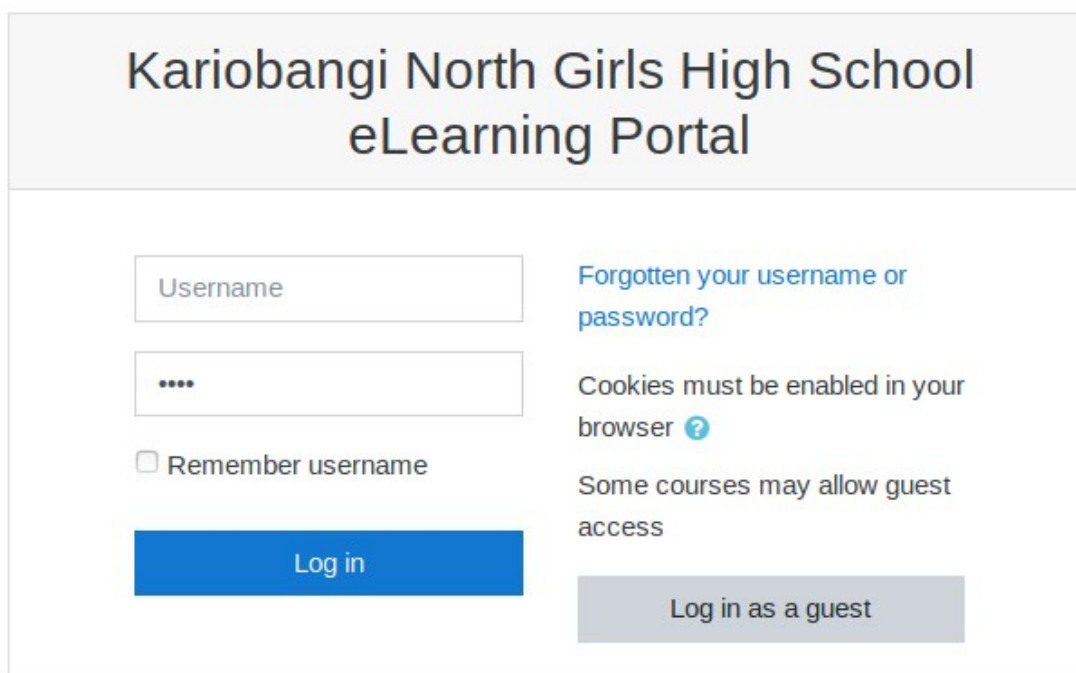
Apache – This is a web server that is able to run PHP.

MySQL Database – This was used for storing data. The data can be retrieved using PHP or other programming languages.

3.9.4 Service Interfaces

The interfaces are essential for providing a link between the system users and the system itself. They provided a platform for sending input to the system and relaying output to the user.

Desktop application



The screenshot shows the login page for the Kariobangi North Girls High School eLearning Portal. The page has a light gray header with the title "Kariobangi North Girls High School eLearning Portal". Below the header, there is a login form with the following elements:

- A text input field labeled "Username".
- A password input field with masked characters "....".
- A checkbox labeled "Remember username".
- A blue "Log in" button.
- A link "Forgotten your username or password?" in blue text.
- A message "Cookies must be enabled in your browser" with a question mark icon.
- A message "Some courses may allow guest access".
- A gray "Log in as a guest" button.

Figure 36: Desktop Application (Log in page)

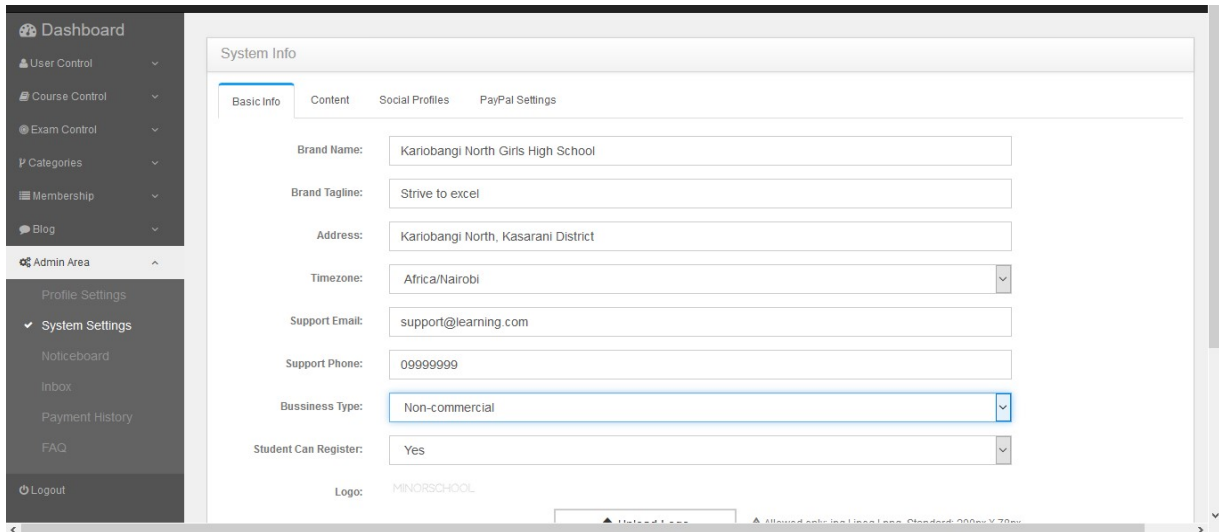


Figure 37: Administrator dashboard

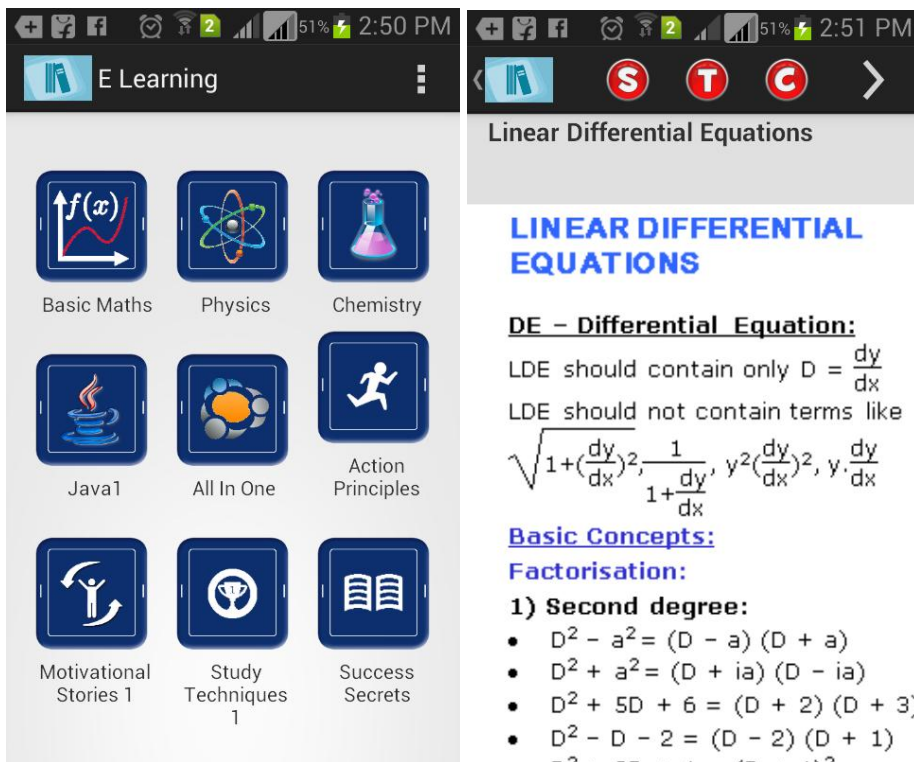


Figure 38: Mobile Application

3.9.5 Sample Development Codes

```
<?php
```

```
class mod_myplugin_some_permission_testcase extends advanced_testcase {
    public function test_isadmin() {
        global $DB;

        $this->resetAfterTest(true); // reset all changes automatically after this test

        $this->assertFalse(is_siteadmin()); // by default no user is logged-in
        $this->setUser(2); // switch $USER
        $this->assertTrue(is_siteadmin()); // admin is logged-in now

        $DB->delete_records('user', array()); // lets do something crazy

        $this->resetAllData(); // that was not a good idea, let's go back
        $this->assertTrue($admin = $DB->record_exists('user', array('id'=>2)));
        $this->assertFalse(is_siteadmin());
    }
}
```

4.1 System functionality testing

The system after the development was tested by various stakeholders. The researcher issued questionnaires to various stakeholders upon testing it to evaluate the functionality performance of the system.

4.2 Service Integration Testing

The service functionality integration testing was done to ascertain whether integrated mobile and web application services through service request and response were working well. These was through both citizens and sectors users. The execution was successful.

4.3 Deployment

The school has a computer lab. Desktop version of the application was installed on one of the computers to serve as the resource server. Other computers connected to the server via a local area network to share the application process. Users therefore were able to access the resources using the computers.

The mobile version android APK was shared to the learners who indicated to have access to a smart phone for installation and registration. The application was used by for a period of four weeks; two towards the end of first term, and two in to the April holiday

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Results

This phase was concerned with service level measurement and monitoring which is continuous and closed-loop way of measuring, monitoring, reporting, improvement of service delivery by the solution.

It's a methodology for establishing acceptable levels of service that addressed business objectives and processes. It was done through prototype user's feedbacks on functionality performance of the system.

4.1.1 System Evaluation

The following was evaluated from the students and subject teachers. They evaluated functionality performance of the eLearning system, on a five point Likert scale (1-5). I used IBM SPSS to analyze the data.

4.1.1.1 Convenience of System test results

From the table 50 above out of 40 respondents, those agreed was 35% and those who strongly agreed was 65%, It was found out that the system was very convenient in for self-learning.

The system provides convenience

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	14	35.0	35.0	35.0
Strongly Agree	26	65.0	65.0	100.0
Total	40	100.0	100.0	

Figure 39: Convenience results

4.1.1.2 System and Content responsiveness test results

That the system content is responsive of the e-Learning system 52.5% strongly agreed, while 47.5% agreed. It was found that the available content could be accessed well by all users.

The e-Learning system content is responsive.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	19	47.5	47.5	47.5
Strongly Agree	21	52.5	52.5	100.0
Total	40	100.0	100.0	

Figure 40: Content responsiveness results

4.1.1.3 Content Relevancy test results

Whether the output content generated by the system is relevant, 47.5% of the 40 respondents Strongly Agreed, 37.5% agreed, while 15% slightly agreed.

The output content generated by system is relevant

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	15	37.5	37.5	37.5
Slightly Agree	6	15.0	15.0	52.5
Strongly Agree	19	47.5	47.5	100.0
Total	40	100.0	100.0	

Figure 41: Content relevance results

4.1.1.4 Usability test results

As to whether the e-Learning prototype is easy to use/learn, 50% strongly agree, 32.5% agree while 17.5% slightly agree. Therefore the prototype is fairly and reasonably usable. With continuous training the respondents who slightly agreed could change to agree.

The e-Learning system is easy to use/learn

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	13	32.5	32.5	32.5
Slightly Agree	7	17.5	17.5	50.0
Strongly Agree	20	50.0	50.0	100.0
Total	40	100.0	100.0	

Figure 42: System Usability results

4.1.1.5 Availability

On the availability of the system, 80% strongly agreed that the system is always available while 20% agreed it is available. The availability of this prototype for use was quite satisfactory.

The system is always available

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	8	20.0	20.0	20.0
Strongly Agreed	32	80.0	80.0	100.0
Total	40	100.0	100.0	

Figure 43: Availability test results

4.1.1.6 Access to Learning materials

Out of the 40 respondents sampled, 47.5% strongly agreed, 50% agreed while 2.5% slightly agreed that the system improves access to learning materials. Learning/revision materials are important for the purpose of expanding knowledge.

The system improves access to learning materials

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	20	50.0	50.0	50.0
Slightly Agreed	1	2.5	2.5	52.5
Strongly Agree	19	47.5	47.5	100.0
Total	40	100.0	100.0	

Figure 44: Access to Learning materials

4.1.1.7 Encouraging Self-Learning

Self-learning is essential as any learning is only efficient when such learning occurs from within and is not compelled by external conditions. In other words, self-learning is driven by a willingness that makes it beneficial for learners to realize the drive and the needed motivation from within in order to enrich such learning

In addition, the luxury of learning at one's own speed and at a moment of choice implies that students can pick up from where they left off as well as learning from any device or place that makes such learning a leisurely experience. 60 percent of participants highly agreed that e-learning adoption promotes self-learning, while 30 agreed.

The system encourages self-learning

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	10.0	10.0	10.0
Agree	12	30.0	30.0	40.0
Strongly Agree	24	60.0	60.0	100.0
Total	40	100.0	100.0	

Figure 45: Encourages self-learning Test

4.1.1.8 Improve Mathematics Performance

Young learners often struggle to understand the basic mathematics concepts that can make it hard to succeed at higher mathematics education levels. In some instances, inability to master basic math concepts early on may prevent learners from later pursuing more sophisticated mathematics classes. But that's not the way it has to be.

Young learners have a variety of skills and they can be used by their parents to assist them comprehend math concepts better. Understanding math approaches instead of memorizing them, practicing them repeatedly, and having a personal tutor are just some of the ways young learners can enhance their math abilities.

This research used e-Learning as a strategy, and on whether the prototype helped improve performance of Mathematics, 42.5% strongly agreed, 32.5% agreed while 15% slightly agreed. 10 % didn't respond to this question. The chart below shows the respondents feedback

The system helped improves performance of Mathematics

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
Agree	13	32.5	32.5	42.5
Slightly Agree	6	15.0	15.0	57.5
Strongly Agree	17	42.5	42.5	100.0
Total	40	100.0	100.0	

Figure 46: Improves Performance

4.1.2 Subject Teachers Results

4.1.2.1 Boost Confidence

Findings from other studies show that our students are conscious of what they are capable of and can determine quite accurately what they know and what they do not know. Children's mathematical confidence affects their approach to challenges and failure. Their attitude to difficulties and inability impacts the mathematical trust of young learners. Apprentices with low self-confidence may fail or make a mistake and decide that they are not smart by that failure. These kids may get angry and give up when faced with a challenge because they feel they're not smart enough to figure it out. On the contrary, learners who see themselves as "intelligent" may think they are not intelligent in any fight.

This could lead them to try to maintain their feeling of "smartness" by avoiding something that could take job. The subject educators agreed that after using the e-learning scheme, there was a significant improvement in trust among learners.

Usage of the system has enhanced student confidence

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	3	100.0	100.0	100.0

Figure 47: Boost confidence Test

4.1.2.2 Performance Improvement (subject teachers feedback)

Who would dispute the concept of a nice thing getting feedback? Common sense and studies make it clear: Formative evaluation, composed of lots of feedback and possibilities to use feedback, improves performance and efficiency. All the three subject teachers agreed that usage of the system has impacted positively on the subject performance. Two of them strongly agreed while one agreed as shown in the chart below.

The system helped improves performance of Mathematics

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	1	33.3	33.3	33.3
Strongly Agree	2	66.7	66.7	100.0
Total	3	100.0	100.0	

Figure 48: Improve subject performance test

Further, improvement in Mathematics performance was measured. This was the main objective of the experimental strategy of this research. Therefore the performance was measured using the end of term examination and compared to the start of the current term examination.

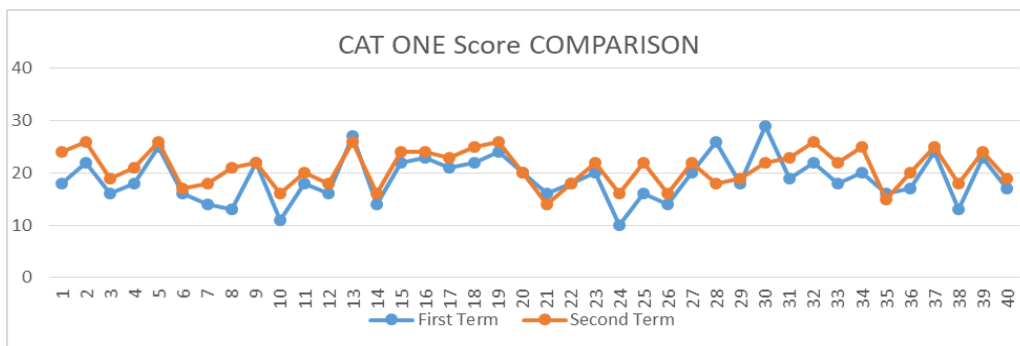


Figure 49: Assessment score comparison graph

The graph above shows the comparison between the continuous assessment tests (CAT) for the first term as the baseline and the first Continuous Assessment Test for second term that is done on the on-set of the term.

Further, the table below illustrates the results for the two assessments. Assessments are marked over a maximum score of 30 marks.

Serial Student	First Term CAT	Second Term CAT
Mean Score	18.95	20.95

Figure 50: Assessment scores

The comparison of the mean scores shows that there has been a slight improvement from the previous score of **18.95** to the most recent score of **20.95**. This improvement could be attributed to the adoption of the e-learning prototype

4.1.2.3 Decision Making

Out of the three (3) Mathematics Subject teacher respondents, one (1) strongly agreed while two (2) agreed that the output information from the system could be used to improve decision making process.

The output information from system improves the subject teacher decision making

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	2	66.7	66.7	66.7
Strongly Agree	1	33.3	33.3	100.0
Total	3	100.0	100.0	

Figure 51: Helps in decision making test

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

In education, "Girls and STEM" is a main sentence. It's important, meaningful and relevant. With a big amount of latest study studies concentrating on STEM, this study focused on how to exploit technology for new strategies aimed at achieving concrete goals.

Motivating students to access the computer from home, from school or from Internet clubs; familiarizing students with internet search for documents useful for learning, contained in a suitable and usable e-learning system will be of help to students to optimize the effectiveness of learning and teaching, which would ultimately boost performance in STEM subjects.

These learners have a range of techniques and their parents can use them to assist young mathematicians comprehend math concepts better. Understanding mathematical alternatives instead of memorizing them, repetitively practicing them and having a personal tutor are just some of the ways young learners can enhance their mathematical abilities

This research used e-Learning as a strategy, and on whether the prototype helped improve performance of Mathematics, 42.5% strongly agreed, 32.5% agreed while 15% slightly agreed. 10 % didn't respond to this question. The chart below shows the respondents feedback

It should however be noted that, there may be other forces affecting the performance of STEM among Girls and adoption e-Learning alone may not be the ultimate solution to this. Lack of confidence may also not be the only impediment to understanding and performing in STEM (Math), this faith has been disproved by scientists like Carol Dweck. According to Dweck (2006), individuals with a fixed mindset think that it is not possible to change our skills and intelligence, while individuals with a development mindset think that our skills can be altered through research, exercise and difficult work. Teachers need to strengthen their students' mindset of development. Mathematical trust represents a growing attitude and involves a desire to persevere, a favorable approach to errors, a readiness to take risks and self-confidence.

Ultimately, the student's mathematical confidence affects their approach to issues and failure. Low self-confidence learners may fail or make a mistake and choose not to be smart. These girls may get upset and give up when confronted with a challenge because they think they're not intelligent enough to discover it out. On the contrary, learners who see themselves as "intelligent" may think that fighting implies they are not intelligent. This may lead them to seek to preserve their sense of “smartness” by avoiding something that might take work.

5.2 Recommendations

In order to solve e-learning problems of students, I recommend that e-learning content be based on hierarchical navigation. With the highest level being the Level of study, then subjects, topics and lessons being the lowest in the hierarchy.

Beginning with a video to introduce the objective of the subject, after the video, the use of a map image is useful to introduce all topics of the subject and show learners all the content of the subject. Inside the topics, lessons would be arranged sequentially.

The learners can visit any topic of the subject from the map image and return to the map. As for topics, a video that introduces them can be inserted together with the PDF file or hypertext file or any other file type relevant to the content. This learning technique is highly flexible in terms of student learning behavior based on hierarchical navigation and includes more than one variety of files (video, PDF, hypertext, etc.).

Further, as the Elaboration Theory (Reigeluth) recommends, the learning tutorials be recorded and arranged by lessons and order of complexity. Each lesson should be accompanied by the relevant revision materials. The topics should belong to a topic.

It is also possible to insert multiple choice questions or practice work or exercises as a way of evaluation.

Finally, considering the economic background of the target population, it would be possible to innovate a way of limiting the resources needed for accessing the system. This means that users would benefit more from a system that can work offline and not necessarily with a steady internet connection.

To could be achieved by using The HTML 5 specification offers two alternatives: a local data storage SQL database API and an offline HTTP application cache to ensure that apps are accessible even if the user is not attached to their network or the internet. By so doing, users without constant internet connection will also stand to benefit.

APPENDICES

Appendix I

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Appendix II:

Permit Letter



**UNIVERSITY OF NAIROBI
COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES
SCHOOL OF COMPUTING AND INFORMATICS**

Telephone: 4447870/4446543/4444919
Telegrams: "Varsity" Nairobi
Telefax: +254-20-4447870
Email: director-sci@uonbi.ac.ke

P. O. Box 30197
00100 GPO
Nairobi, Kenya

Our Ref: UON/CBPS/SCI/ MSC/AC/2016

28th February 2019

Kariobangi Girls High School
Nairobi


Dear Sir/Madam

RE: RESEARCH PERMIT – MULI FRANCIS MUTISYA REG. NO. P51/85625/2016

The above named is a bona fide student pursuing an MSc course in Applied Computing Management at the School of Computing and Informatics, University of Nairobi. He is currently carrying out his research on the project entitled "*Adoption of E-learning as a Tool to Close the Stem Gender Gap and Improve Completion Rates among Girls in Secondary Schools*". The project involves gathering relevant information from various institutions and he has informed the office that he would wish to carry his research in your organization and is under supervision of Prof. R.O. Oboko.

We would be grateful if you could assist Mr. Mutisya as he gathers data for his research. If you have any queries about the exercise please do not hesitate to contact us.

Yours sincerely


DR. AGNES N. WAUSI
DIRECTOR
SCHOOL OF COMPUTING AND INFORMATICS

School of Computing & Informatics
University of NAIROBI
P. O. Box 30197
NAIROBI

ANG/jsn

Appendix III:

Research Authorization



KARIOBANGI NORTH GIRLS SECONDARY SCHOOL
P.O. Box 44078-00100 NRB, Cell: 0723 - 09446
Email:kngs1@YAHOO.COM

Our Ref:.....
Your Ref:.....

To,

The director
School of computing,
Nairobi University.

25th March 2019.

Dear sir/madam

RE: PERMISSION TO DO THE RESEARCH.

This is to notify you that Francis Muli a student at university of Nairobi has been allowed to do his research on “**adoption of e-learning as a tool to close the STEM gender gap and improve completion rates among girls in secondary school**”. Starting from 27th February 2019 at Kariobaigi north girls.

He has been allowed to use some of form one mathematics and computing classes during the research.

We hope that we are of help.

Yours sincerely,


Mrs. Emilly Achieng Adhiambo.
Principal.
Kariobangi North Girls.



MOTTO: STRIVE FOR EXCELLENCE

Appendix IV

Data Acquisition Questionnaires

Pre-Study Research Questionnaire

Student Respondent

MULI Francis Mutisya is a Masters student at the University of Nairobi, registration number P51/85625/2016. I am kindly requesting you to participate in filling the questionnaire below for my University research project. This will enable me to carry out my project in Msc. Applied Computing research titled: *E-Learning as a Tool to Improve STEM Performance among Girls in Secondary Schools Case of Kariobangi North Girls Secondary School*

The information being sort is purely and basically for academic purposes and will not be used otherwise

Instructions

- i. Do not write your name on this material.*
- ii. Please attempt all the questions*
- iii. Tick where appropriate*

SECTION ONE: BACKGROUND INFORMATION

1. What is your Gender?

- Male
 Female

2. Which Level of secondary education are you?

- Form One
 Form Two
 Form Three
 Form Four

SECTION TWO: COMPUTER LITERACY

3. Do you know how to use a computer?

- Yes
 No

4. Do you know how to use a smart phone?

- Yes
 No

5. Do you know how to use the internet?

- Yes
 No

6. Do you have access to internet while at home?

- Yes
 No

7. Do you have access to a computer while at home?

- Yes
 No

8. Do you have access to a computer while at school?

- Yes
 No

9. Do you have access to a smart phone while at home?

- Yes
 No

SECTION THREE: MATHEMATICS PERFORMANCE AND CHALLENGES

10. How was your performance in Mathematics in the last term examinations?

- Very Good
 Good
 Average
 Below Average
 Poor

11. How do you find Mathematics?

- Very easy
 Easy
 Difficult
 Very difficult

12. What are your major challenges in understanding Mathematics subject?

Lack of sufficient Text Books

Lack of Enough self-practice

Lack of technology in the learning process

Lack of interest

Others:

specify.....

13. Do you have all the required Text books for Mathematics?

Yes

No

SECTION FOUR: TIME MANAGEMENT

14. According to the time table, how many Mathematics Lessons do you cover in a week?

One

Two

Three

Four

15. How long is one Mathematics lesson?

One Hour

Two Hours

Others: Specify..... *40 minutes*.....

16. Are you always present during the lessons?

Yes

No

17. What time do you get home from school in a normal school day?

5 - 6 PM

6 - 7 PM

Beyond 7 PM

18. Do you attend school on Weekends?

Yes

No

19. Do you usually undertake self-study during the time you are home?

Yes

No

SECTION FIVE: E-LEARNING PREPAREDNESS AND AWARENESS

20. Do you have any knowledge on E-Learning?

Yes

No

If yes how do you rate it?

Very knowledgeable

Sufficiently knowledgeable

Slightly knowledgeable

Not knowledgeable

21. Suppose an E-Learning system is to be introduced to assist you in your self-study while not in school, how helpful would it be?

Very helpful

Helpful

Little help

Not helpful

22. Which technology are you likely to prefer for the E-Learning system if made available?

Mobile Application

Web application

SMS

Desktop Application

Specify Others.....

23. Suppose a suitable E-Learning system is to be used to assist you in your self-study while not in school, how would it be of help in improving your performance in Mathematics?

Very helpful

Helpful

Little help

Not helpful

Am not sure

Thank you for your time!

Subject Teacher Questionnaire

MULI Francis Mutisya is a Masters student at the University of Nairobi, registration number P51/85625/2016. I am kindly requesting you to participate in filling the questionnaire below for my University research project. This will enable me to carry out my project in Msc. Applied Computing research titled: *E-Learning as a Tool to Improve STEM Performance among Girls in Secondary Schools Case of Kariobangi North Girl's Secondary School*

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Instructions:

- i. *Do not write your name on this material.*
- ii. *Please attempt all the questions*
- iii. *Tick where appropriate*

SECTION ONE: BACKGROUND INFORMATION

1. How old are you?

- 18 to 34
- 35 to 49
- 50 to 70
- Over 70

2. What is your Gender?

- Male
- Female

3. How long have you taught Mathematics?

- Less than 1 Year
- 1 to 2 Years
- 3 to 5 Years
- Over 5 years

SECTION TWO: EXISTING METHODS OF TEACHING

4. How long does it take you to prepare a lesson for teaching?

- Few minutes
- Within an Hour
- Other specify.....

5. What is your experience with the conventional teacher to student method of teaching?
- Very easy
- Easy
- Difficult
- Very difficult
6. How do you rate this method of teaching/course delivery?
- Very effective
- Effective
- Slightly effective
- Not effective
- I don't know
7. How was the performance of your students in Mathematics in last term's examination?
- Very Good
- Good
- Average
- Below Average
- Poor
8. According to the approved timetable how many Mathematics lessons are scheduled in a week?
- One
- Two
- Three
- Four
9. How long is one Mathematics lesson?
- One Hour
- Two Hours
- Others: Specify..... *40 minutes*
10. Do you think that the allocated time is sufficient?
- Yes
- No
- If No, Why? *Students might need time for self practice.*

11. Which topic of Mathematics are you currently covering?
..... Angles & plane figures

12. How long does one topic take to teach?
..... 2 weeks

13. Do you give Class Exercises to during/after every topic?

- Always
- Often
- Sometimes
- Rarely
- Never

14. If yes, what is the main reason for this?

- Measure Understanding
- It's a requirement by the school
- Identify Challenges
- All of the above

15. Do you keep records of performance for the exercises scores?

- Yes
- No

16. According to your expert opinion and based on experience, would a significant change in performance in one topic be an indicator of a change in performance for the entire subject for the whole class?

- Yes
- No

17. Do you keep records of performance for the exercises scores?

- Previous class performance on the same topic
- Last topic Performance on the same class
- Another stream class (not within the target population) performance on the same topic
- Same class with students who are out of the Sample

18. What are you major challenges that you encounter teaching using the conventional method?

- Inadequate Resources (Text books etc)
- Difficulties covering the Syllabus
- Lack of proper teaching tools
- Student Absenteeism
- Others: Specify.....

SECTION THREE: E-LEARNING KNOWLEDGE

19. Do you have knowledge on E-Learning tools?

- Yes
- No

20. Have you interacted with an E-Learning platform/system before?

- Yes
- No

21. Do you think technology can be used to enhance teaching of mathematics in secondary school?

- Yes
- No

22. Suppose an E-Learning platform is to be used to assist your students in self-study while not in school, how helpful would it be?

- Very helpful
- Helpful
- Little help
- Not helpful
- Am not sure

23. If your class students were to be given several technologies to use in the E-Learning Platform, which methods do you think would be more suitable?

- Mobile application
- Web application
- SMS
- Others specify.....

Thank you for your time!

Interview Checklist

Computer Studies Teacher Interview

MULI Francis Mutisya is a Masters student at the University of Nairobi, registration number **P51/85625/2016** I am kindly requesting you to participate in responding to the questions below for my University research project. This will enable me to carry out my project in Msc. Applied Computing research titled: *E-Learning as a Tool to Improve Stem Performance Among Girls in Secondary Schools Case Of Kariobangi North Girls Secondary School*

The information being sort is purely and basically for academic purposes and will not be used otherwise

Interview Checklist

1. How old are you?
2. What is your Gender?
3. How long have you taught Computer studies?
4. Do you teach using practical lessons?
5. How was the performance of your students in Computer studies in last term's examination?
6. Which topic of Computer studies are you currently covering?
7. How long does one topic take to teach?
8. Based on the previous performance, how would you rate Form 1 Red Computer literacy?
9. In your expert opinion are students in Form One Red able to utilize E-Learning? Yes
10. If Form One Red students were to be given several technologies to use in the E-Learning Platform, which methods do you think would be more suitable?

Functionality Questionnaire

Student User

No.	Please indicate the extent to which you agree with the following statements on functionality performance of the e-Learning System, on a five point Likert scale (1-5). Please tick (✓) appropriately in the boxes provided.	Strongly Agree	Agree	Slightly Agree	Disagree	Strongly Disagree
	Functionality performance of the system	5	4	3	2	1
1.	The system provides convenience.	✓				
2.	The e-Learning system content is responsive.		✓			
3.	The output content generated by system is of relevant.	✓				
4.	The e-Learning system is easy to use/learn		✓			
5.	The system is always available	✓				
6.	The system improves access to learning materials		✓			
7.	The system encourages self-learning		✓			
8	The system helps improves performance of Mathematics		✓			

Subject Teacher User

No	Please indicate the extent to which you agree with the following statements on functionality performance of the e-Learning System, on a five point Likert scale (1-5). Please tick (✓) appropriately in the boxes provided.	Strongly Agree	Agree	Slightly Agree	Disagree	Strongly Disagree
	Functionality performance of the system	5	4	3	2	1
1	The system provides convenience.	✓				
2	The e-Learning system with its content is responsive.		✓			
3	The output content generated by system is relevant.	✓				
4	The e-Learning system is easy to use/learn	✓				
5	The system provides saves resources	✓				
6	The system improves access to learning materials		✓			
7	The system encourages self-learning		✓			
8	Usage of the system has enhanced student confidence	✓				
9	The system helped improves performance of Mathematics	✓				
10	The output information from system improves the subject teacher decision making.	✓				

Appendix V

Images

School Computer Lab

