

Implementing Mobile Based Interface for eLearning
A Case Study of SODEL

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2019

Declaration

Declaration by Student

I JAMES NJOROGGE NJUGUNA hereby declare that this research project is my original work and has not been presented in another university or institution for consideration for any academic certification.

Sign

Date.....

James Njoroge Njuguna

Declaration by Supervisor

This is to certify that the research project has been submitted for examination with my approval as University supervisor

Sign

Date.....

Nancy Macharia

Project Supervisor

Dedication

I dedicate this research to my inspiring parents for their efforts, sacrifices, mentorship, and guidance through this course.

I also dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this research

Acknowledgement

First, I therefore take this opportunity to express my sincere gratitude to the Almighty God for this far He has brought me and for providing me with the opportunity to carry out these research activities.

I also like to acknowledge the work of my supervisor, for guidance and support in coming up with the correct research format.

I would also like to thank my parents for their moral and financial support throughout the research period.

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Abbreviations and Acronyms

1. CEP – Continuing Educational Programme
2. GQM - Goal Question Metric
3. HCI- Human Computer Interaction
4. ICT- Information Communication Technology
5. JKUAT – Jomo Kenyatta University of Agriculture and Technology
6. LMS – Learning Management System
7. OMG- Object Management Group
8. PACMAD - People at the Centre of Mobile Application Development
9. SODeL – school of open, distance and e learning
10. SDK- The Android Software Development Kit
11. SPEM- Software Process Engineering Meta-Model Specification
12. UCD - User Centered Design
13. UI - user interface
14. UML- Unified Modelling Language

Definition of Terms

1. Usability- The official ISO 9241-11 definition of usability is: “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”
2. Responsive Web Design – responds to the needs of a user and the devices they are using. The layout changes on the size and capabilities of the device. (“Ethan”, 2010).

CHAPTER 1

1.0 Introduction

Jomo Kenyatta University of Agriculture and Technology is a Higher Educational Institution located 35 kilometers North East of Nairobi along the Thika highway in Juja.

The university has several colleges and schools each offering different programs to students. One of the schools is the School of Open, Distance and eLearning (SODEL).

The School of Open, Distance and eLearning (SODEL) previously known as Continuing Educational Programme (CEP) was inaugurated in 2012 following the amalgamation of the CEP and eLearning sections thus enhancing the quality delivery of programmes. The enhanced mandate incorporates Jomo Kenyatta University of Agriculture and Technology (JKUAT) continuing education, Distance learning, Open learning and eLearning modes of study which allows a student to attain internationally Jomo Kenyatta University of Agriculture and Technology academic qualifications at own convenience.

1.1 Problem Statement

A high number of students' own use smart phone compared to those owning laptop and desktops

In SODEL the learning materials are accessed only from a web based eLearning system using a web browser the content is not automatically adjusted to accommodate the student device and context.

Mobile learners have difficulties in accessing course content on the web interface therefore the learners have to adjust the layout for a friendlier viewing as the content appears in tiny fonts that are not user friendly this reduces students' motivation. Jung (2017) observed that learner motivation is fundamental to the learners' success in an online coursework environment.

1.2 Proposed Solution

Implement mobile interfaces for eLearning by developing a mobile application with improved interface for the learning processes with various units.

1.3 Objectives

1. Examine approaches for designing interfaces for mobile devices.
2. Establish necessary usability dimensions for mobile application
3. Establish methods of evaluating the mobile interface for eLearning.
4. Implement a mobile application for eLearning.

1.4 Research Questions

1. What are the approaches for designing interfaces for mobile devices?
2. What are the necessary usability dimensions for mobile applications?
3. What are the methods of evaluating interfaces?
4. How will the implementation be carried out?

1.5 Justification

Improving the interface of the eLearning system will bring several benefits among them

1. The eLearning enhances training and learning in that student can access materials and contents on the eLearning platform as from the mobile devices from anywhere as long as there is an internet connection thus improving learning activities.
2. It will be more convenient education alternative for other people who wish to improve their knowledge on emerging technologies

1.6 Scope

This research project will cover the implementation of a mobile-based interface for e-learning for IT students in various emerging technologies in Jomo Kenyatta University of Agriculture and Technology. The interface will only be limited to mobile (smart phones) and will be user friendly for students to interact with the learning materials.

The back-end of the application will entail storing of the students data such as authentication details and course contents

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

E-learning technology is one of the most effective assets for growing knowledge, skills and development in any institution of learning. The e-learning technologies are driven by the use of Information and Communication Technology (ICT). ICT refers to the totality of methods and tools that are used in gathering, storing, processing and communicating information (Olutola & Olatoye 2015).

Mobile based interface

A mobile user interface is the graphical and usually touch-sensitive display on a mobile device, such as a smartphone or tablet that allows the user to interact with the device's apps, features, content and functions.

Rouse Margaret. (2019) observed that mobile user interface (UI) design requirements are significantly different from those for desktop computers. The smaller screen size and touch screen controls create special considerations in UI design to ensure usability, readability and consistency. In a mobile interface, symbols can be used more extensively and controls may be automatically hidden until accessed. The symbols themselves must also be smaller and there is not enough room for text labels on everything, which can cause confusion.

Users have to be able to understand a command icon and its meaning whether through legible text or comprehensible graphical representation. Basic guidelines for mobile interface design are consistent across modern mobile operating systems.

Other types of interface include web-based interface. Web based interface is the interaction between a user and software running on a Web server. The user interface is the Web browser and the Web page it downloaded and rendered.

2.2 Interface design

User interface (UI) design is the process of making interfaces in software or computerized devices with a focus on looks or style. Designers aim to create designs users will find easy to use and pleasurable. UI design typically refers to graphical user interfaces but also includes others, such as voice-controlled ones.

2.2.1 Approaches to Designing Mobile Based Interfaces.

Mobile task

A task can be visualized as a use case scenario based on product operation or application task. Studies by Biel et al. (2010) categorized task as functionality, workflow, interactions, duration, type, complexity and dependency.

Studies by (Raita et al., 2011) states that task difficulty can be measured in terms of product expectations.

Mobile technology

Device characteristics and features, hardware, software and network connectivity can categorize device profile (Biel et al., 2010). As this study concerns mobile devices, it covers the characteristics pertaining to mobile technology. According to Heo et al. (2009), they defined mobile devices as portable, self-contained information to the communication system.

According to studies by Ali et al., (2012) there are three main features of mobility: they use user's hands, operated without cables, support applications and connected through the Internet.

Mobile environment

The environment can be viewed as geographic location, environmental data such as temperature, noise, social conditions such as a group of users or event that take place. It also covers the stability of connections and the capabilities of device to collaborate with others (Biel et al., 2010).

The figure below shows context

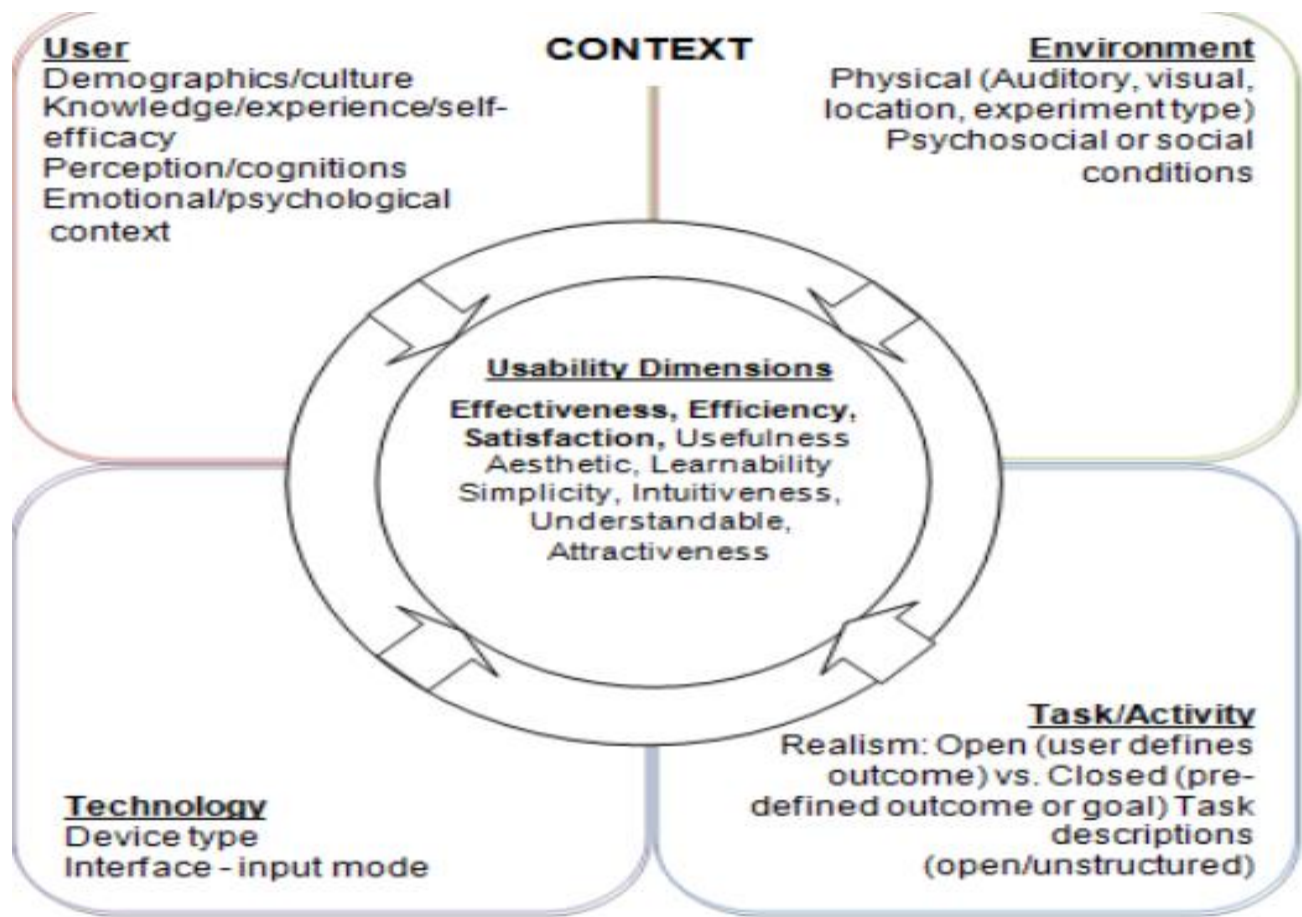


Figure 1 Usability Dimensions Context

2.2.2 Mobile Based Interface for E-learning

E-learning involves learning through the use of Information and Communication Technology (ICT) infrastructures.

Rosenberg (2001) defines learning as “the process by which people acquire new skills or knowledge for the purpose of enhancing their performance”.

Studies by Georgieva et al., (2004) found that mobile-based interface is a natural extension of E-learning and has the potential to make learning even more widely available and accessible to the smart phone users. It offers open doors for the advancement of cooperation among lecturers and students.

2.2.3 Requirement for Designing Mobile Based Interface for eLearning

1. Respect the platform

We documented patterns and components based on native operating systems that we have apps on: iOS and Android. When designing for native platforms, one should consistently refer to the native OS design guidelines first for maximum quality. Keep in mind that native platform guidelines constantly evolve, so it's always good practice to stay on top of these guidelines and refresh memory and knowledge often.

2. Focus on the customer benefit

Always design for the customer benefit first. No use case is the same, and many use cases have exceptions. Do not design something simply because you can reuse a pattern or component for another feature. Design patterns help ground us as a system and unify an experience across an ecosystem of products, but they should by no means be the first or last stop in the design process. Always question yourself: How will this benefit the customer?

3. Think device first

Push your thinking beyond “mobile first.” Start thinking about leveraging device capabilities first. The native mobile device has a lot to offer: touch, voice, pressure, location tracking, accelerometer, notifications, etc. You are designing around the device, the platform, the user experience. How can these device features be utilized in our products? How can the mobile device benefit users beyond the screen interface in front of them?

4. Keep scalability in mind

Scalability across devices, more specifically between a phone and tablet, is a common challenge among designers. When we think of mobile devices, we know there are tablets, phones, phablets. Some of the recurring questions I get asked are: Should there be parity between web and tablet designs? Can we translate the phone patterns to be the same on tablets? How do we design for phablets? To answer these questions, we researched with users, took an in-depth look at device interfaces and screen sizes, and set some standards. While the phone and tablet share many similarities, users use them very differently.

2.2.4 Methods for Implementing Mobile Based Interface for eLearning

School of Open, Distance and eLearning (SODEL) has developed an LMS (Learning Management System) based on Moodle. Until now SODEL Mobile application development has never been done, but one of the strategies to increase the use of LMS is by developing a mobile application. At the time of developing the application, the risk of failure also needs to be considered. According to Weinschenk, three of the 12 common causes of failure of software development projects are closely related to the user experience: the needs are not well defined; Lack of communication between developers and users; And stakeholder politics. Weinschenk also added that the user experience problem can be overcome with user-centered design, which focuses on gaining a deep understanding of the pre-users throughout design and development life-cycle. Therefore, it is necessary to implement and evaluate the SODEL Mobile design with user-centered design into mobile application.

2.2.4.1 Based on User-Centered Design

Banimahendra et al., (2018) notes that User Centered Design (UCD) is a framework of designing and developing products that focus on understanding the potential users. This framework also guarantees the

product will be easy to use. The International Usability Standard ISO 13407, which is the basis for UCD, stated six things that must be pointed out in UCD. It emphasizes the user involvement in design, development, and evaluation.

2.2.4.2 Android Platform-Based Application

Platform-based apps are an application that is specifically created and used on a specific platform, for example only on the Android operating system. This type of application is developed using a specific programming language (e.g. Java), but is more dependent on the use of application frameworks, supporting libraries and runtimes in the form of thousands of lines of code typically written in C and C++. In the Android operating system, applications are usually developed using the Java programming language with the help of application frameworks that provide access to the API framework so that it can be used by core applications

2.2.5 Methods for Evaluation

According to studies by Saleh et al., (2015) Usability measurement is tedious work, particularly for current smart mobile devices. With an increasing capacity for greater user interactivity through a range of tasks and in a variety of contexts during time, the importance and impact of mobile device context-of-use components is of particular interest to researchers. PACMAD (People at the Centre of Mobile Application Development) was introduced as comprehensive usability model for mobile applications to evaluate usability based on usability factor; user, context of use, and task. PACMAD model identified the usability attributes without considering related low level metrics which represents each attribute. Thus, there is a need to be extended to include relative low level metrics in addition to usability attributes.

PACMAD usability model and Extended PACMAD

The study of Harrison et al., (2013) introduced a new usability model named PACMAD (People at the Centre of Mobile Application Development) to overcome the limitations that exists in the present usability models used to measure the usability of mobile.

According to studies by Ojokoh. (2015) the mobile devices require specific usability models. They thus developed the PACMAD. The point of their model is expanding existing ease of use models, for example, Nielsen's or the ISO, to the setting of versatile applications. For instance, they contended that, during the application advancement, extra usefulness administrations can be attached to a product application to permit client greater achievement with the application. However, when it comes to mobile devices, this additional functionality increases the software complexity. Thus, the user's primary goal became difficult to accomplish via the device. The PACMAD model has seven parts. For each, the

creators offer definitions, measures, and affiliations. The segment adds up to Effectiveness, Efficiency, fulfillment, learnability, memorability, blunders and psychological burden. The consideration of intellectual burden is considered as PACMAD's ease of use model fundamental commitment for the investigation of ease of use. Like models, PACMAD likewise needs rules and measurements identified with picked measurement and furthermore expect assessment to look at its precision for portable applications. Therefore, fill this hole by stretching out PACMAD to incorporate relative low dimension measurements notwithstanding ease of use traits. This Extended variant contains 21 measurements. GQM (Goal Question Metric) advisers for create ease of use measurements coordinating those measurements yielded from writing. Two assessment instrument undertaking rundown and client fulfillment poll are utilized to gather objective and emotional information for complete ease of use assessment of broadened PACMAD.

Conclusion

Considering the above statements designers should aim to create designs that are users will find easy to use considering the mobile tasks, mobile technology and environment.

Designers need to consider the following requirements when designing for mobile .They need to respect the platform, focus on the customer benefit, think device first and keep scalability in mind.

Improving usability increases efficiency, effectiveness, fulfillment, memorability, and reduces psychological burden

CHAPTER 3

SYSTEM ANALYSIS AND DESIGN

3.1 Introduction

This chapter covers system analysis and design together with various methods that we used to collect the data that is important for development of the mobile interface for e-learning.

3.2 Feasibility Study

The motivation behind doing feasibility study is essentially to assess the proposed framework potential for progress dependent on its functionality, meeting clients' necessities, successful utilization of assets and obviously its cost adequacy. To profoundly assess the proposed framework my plausibility study will be arranged into a few kinds that incorporates:

3.2.1 Operational Feasibility

Operational feasibility refers to the proportion of taking care of issues with the assistance of another proposed framework. It helps in exploiting the chances and satisfies the prerequisites as recognized during the improvement of the task. It takes care that the administration and the clients bolster the venture. It is mainly related to human organizations and political aspects. Some of the things to consider are:

What changes will be brought with the system?

What organization structures are disturbed?

What new skills will be required? Do the existing staff members have these Skills? If not, can they be trained in due course of time?

The system is operationally feasible as it very easy for the End users to operate because they only needs basic information about using an android smartphone and they will be good to go.

3.2.2 Economic Feasibility

This study looked at the financial assessment of the project in terms of cost-benefit analysis. It ensures that the system will be affordable.

Economic Feasibility Report

According to the analysis done, the organization will incur some cost in purchasing additional hardware equipment's and software. The purchasing of computers and its peripherals while software cost involves the required software cost, facility cost on money spent in preparation of the physical site where the system will be operational such as cabling, flooring and the lighting in additional to air conditioning.

Also, development cost which include the wages and the equipment used in addition to training the staffs, operational cost such as supplies, the maintenance fee of hardware and the software and money paid to professionals responsible for running and maintaining the system.

Users of the interface need to acquire smart phones to be able to interact with the learning materials.

3.2.3 Technical Feasibility

To be successful for the implementing of the system, the following tools will be required:

Programming tools/Software's

- i. Windows 10 Operating system: To provide a platform for accessing the system.
- ii. There is need for backend to manage users data
- iii. Android Studio: To provide a platform for writing the code.
- iv. Database server: to be used for establishing connection between the database and the system.
- v. Adobe reader: to be used for reports.

Microsoft word: To be used in writing of project documentation and manuals

Hardware

- i. Computer: Core i3. 4GB of RAM 250GB hard disk or higher specifications, to run the application.

2GB Flash Disk: To occasionally port data to another computer if need arises

- ii. An android phone for testing purposes

3.3 Requirement Elicitation

A requirement refers to a statement of what the system must do or what characteristic it needs to have (Dennis et al., 2012)

Data Collection

Several methods were used to collect the data relevant to the development of the mobile application for e-learning

1. Observation

Data was collected by observing the current system

Advantages of Observation

- i. Simplest Method
- ii. Greater Accuracy

- iii. Universal Method
- iv. Observation is the Only Appropriate Tool for Certain Cases

2. Questionnaire

Here, formulated questions which both were open ended and close ended and were issued to the stakeholders (staff and students) who complied by giving their responses. This tool helped in the collection of data

Advantages

- i. Was easy to analyze data since the questions that were asked were straightforward.
- ii. Reduced Bias in that most of the questions were in closed format and had answers and therefore answers were straightforward.
- iii. It was relatively quick to collect information since most of the people that were required to answer the questions were available when needed.

3.4 Data Analysis

Analysis of the findings

Below are the individuals who were involved during the data collection phase.

People Involved in Data Collection Process	Number of People Involved
students	10
staff	2
Total	12

Table 1 Questionnaire sample3.4.1 Questionnaires Report

After collecting the data using this tool, the following graphs shows the analysis of some of the major questions contained in the questionnaires for the stakeholders

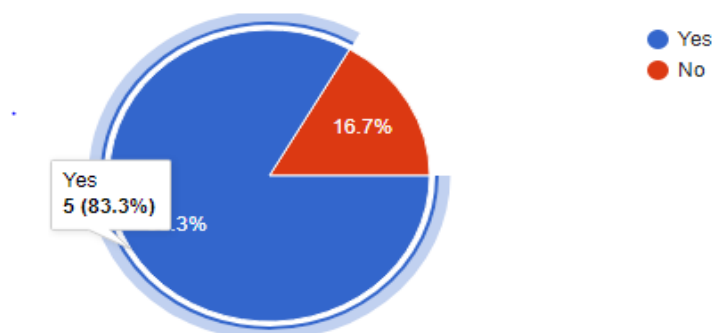


Figure 2 Questionnaire Report

According to the data collected from a random sample of students from the Jomo Kenyatta University of Agriculture and Technology who have interacted with the web based SODEL e-learning system 83% recommended that it to have a mobile application developed.

The figure below shows the sampled data from the stakeholders on how long it takes for the systems to execute in terms of runtime and memory.

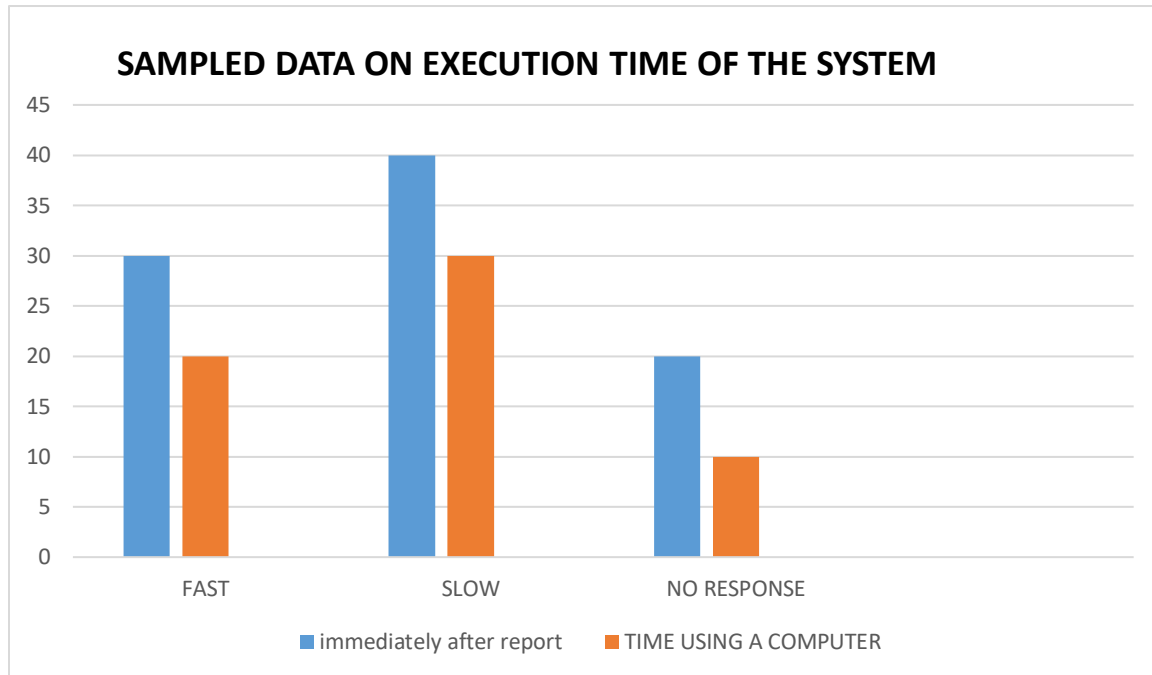


Figure 3 Sampled data on execution of the system

Conclusion

According to the analysis shown above, implementation of the proposed system will be of great value to the students and will enhance learning of new skills.

3.5 System Development Methodology

3.5.1 The Unified Process

The unified process is a use-case-driven, architecture-centric, iterative and incremental development process framework that leverages the Object Management Group's (OMG) UML and is compliant with the OMG's SPEM (Software Process Engineering Meta-model Specification)

The unified process is broadly applicable to different types of software systems, including small-scale and large-scale projects having various degrees of managerial and technical complexity, across different application domains and organizational cultures.

3.6 System specification

System specification describes the features and behavior of a system or software application. It includes a variety of elements that attempts to define the intended functionality required by the customer to satisfy their different users. System specification also defines at a high-level the main business processes that will be supported, what simplifying assumptions have been made and what key performance parameters will need to be met by the system.

Functional requirements

The application is expected to do the following.

1. Allow Authentication of users’.
2. Manage and store users’ information.
3. Display the courses contents
4. Manage the courses content
5. Display course search results

Nonfunctional requirement

The non -functional requirements are as follows:

Maintainability

The administrators should have the ease of maintaining the system by, correcting errors, preventing breakdown, perfecting the system and ensuring that it adapts to the changing needs of the user.

Usability

The system will be friendly to all users due to simple user interfaces and proper documentation of the system.

3.7 System Design

System design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements. System design therefore is the process of defining and developing systems to satisfy specified requirements of the user.

3.7.1. Logical Design

What a system is doing will change less over time than how it is doing it. This is often conducted via modelling using use case diagrams, class diagrams, Entity- Relationship Diagram to show the flow of activities. In this way, we can furnish an abstraction of the total system through logical design in an orderly explanatory way.

Activity Diagram

The activity diagram shows various that take place from start when a user logs in the application

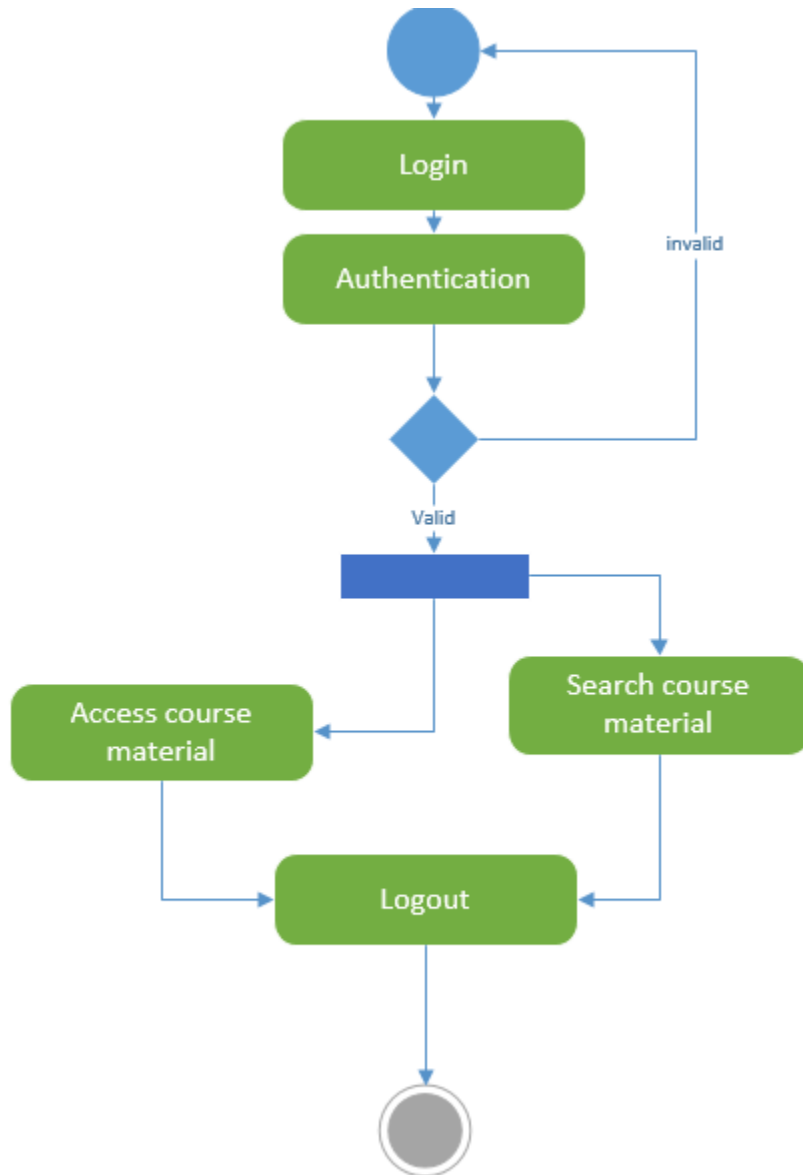


Figure 4 Activity Diagram

Flow chart diagram

It shows the flow of activities when a student logs in.

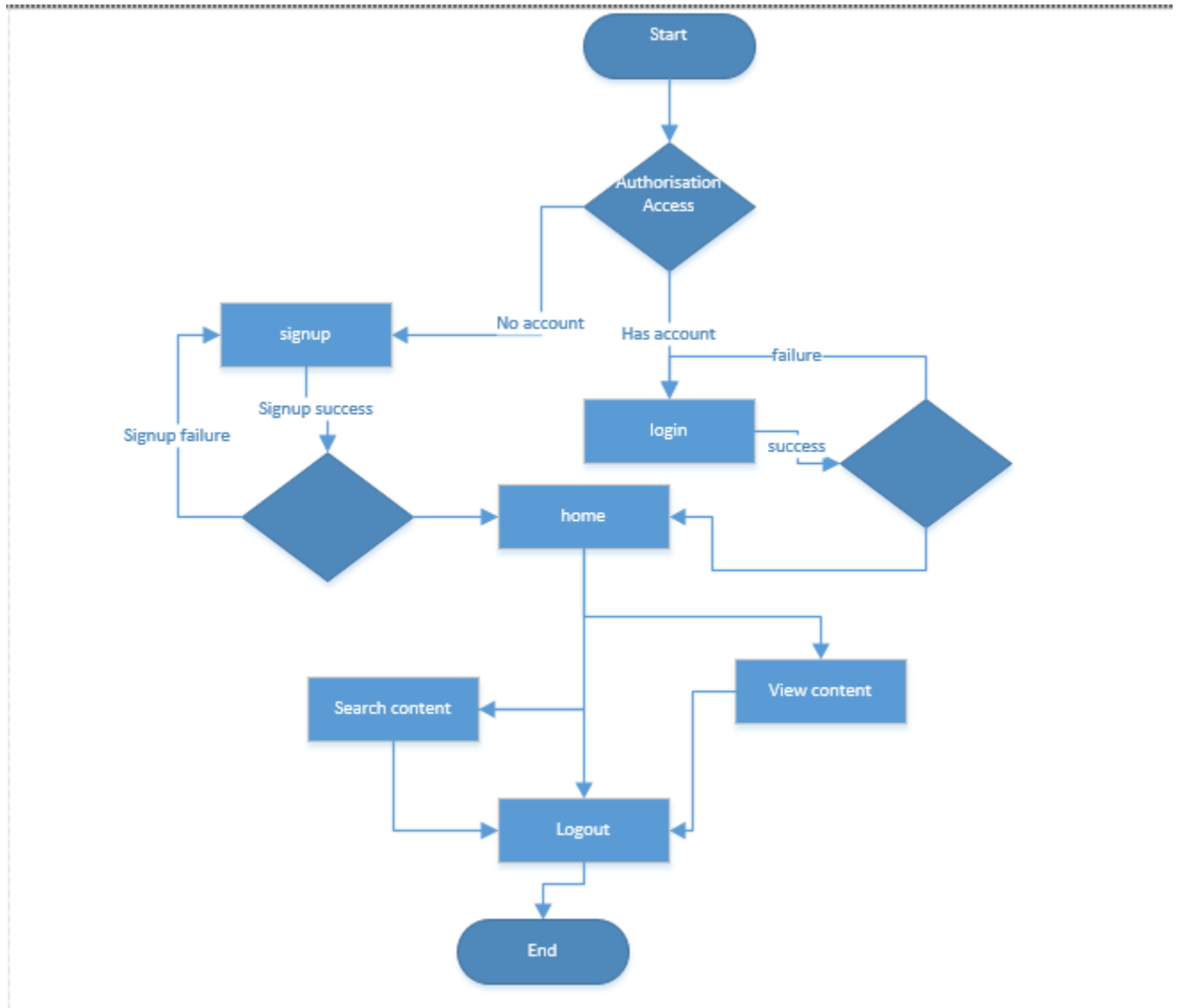


Figure 5 Flow Chart Diagram

Use case diagram

Use case diagrams give a graphic overview of the actors involved in a system together with their different and how these different functions are interacted

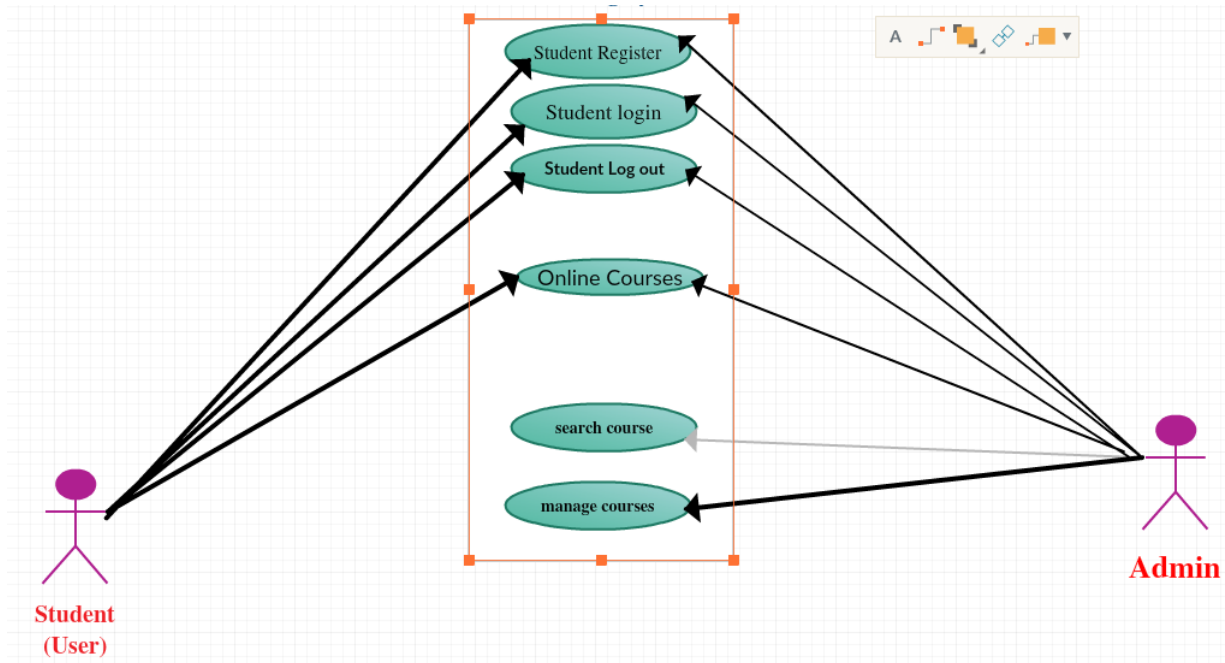


Figure 6 Use case Diagram

Sequence Diagram

Sequence diagram, shows how different stakeholders interact with a system by showing activities performed by different stakeholders.

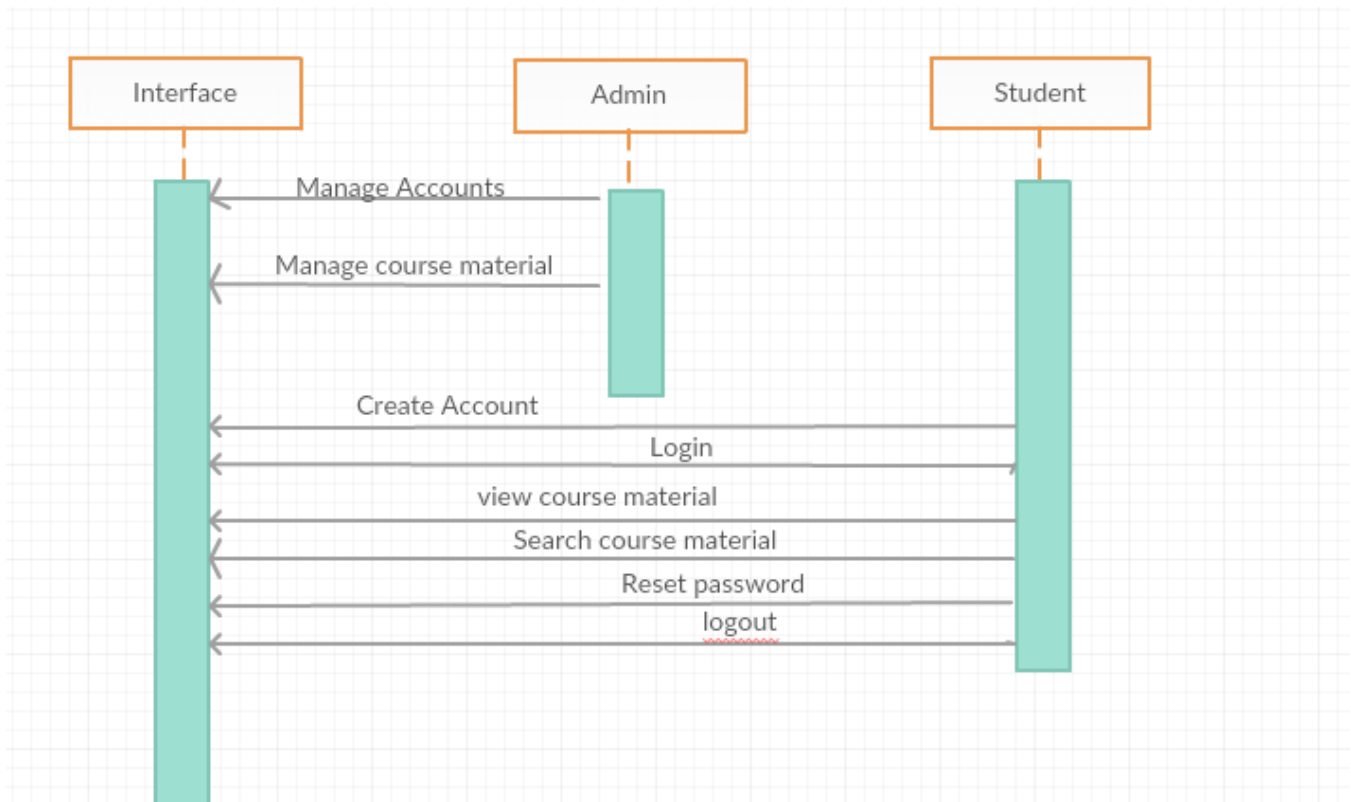


Figure 7 Sequence Diagram

3.7.2 Database design

This is the process of producing a detailed data model of the database. This data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a data definition language which can then be used to create database. This is also carried out in order to reduce redundancy of information.

The zero normal form (ONF) The un-normalized/the zero-normal form data sets would be:

Un-normalized Tables of Data

User_id, User_name, User_phone, Admin_id,

Admin_id, Admin_username, Admin_password

The First Normal Form (1NF)

All columns must be atomic (no repeating groups). Once the un-normalized data set has been identified, it is converted into the first normal forms and primary keys are identified.

Table 1: student_id, student_name, student_email,

Table 2 course_id, course_name, course_description, admin_id

The second normal form (2nf)

This is where all non_key field depend on component of the primary key. This is guarantee when the primary key is a single field and there must be in first normal form.

course_name, course_description,

The third normal form (3nf)

This is where a table must be in second normal form.

No non-key fields depend upon another. That is all non-key field depend on primary key.

Admin_id=admin_username, admin_password, admin_phone

The database system should have the following tables;

Field Name	Data type	Primary Key	Null
Admin_Id	Int (10)	Yes	No
Username	Varchar(20)	No	No
Password	Varchar (20)	No	No
Phone	Int(20)	No	No

Table 2 Admin Table

Field Name	Data type	Primary Key	NULL
student_id	Varchar (20)	Yes	No
Email	Varchar (20)	No	No
Password	Varchar (20)	No	No
Admin_id	Int (20)	No	No

Table 3 Student Table

Field Name	Data type	Primary Key	Null
course_id	INT (30)	Yes	No
Course_name	Varchar (20)	No	No
Course_description	Varchar (255)	No	No

Table 4 Courses Table

Entity Relationship Diagram

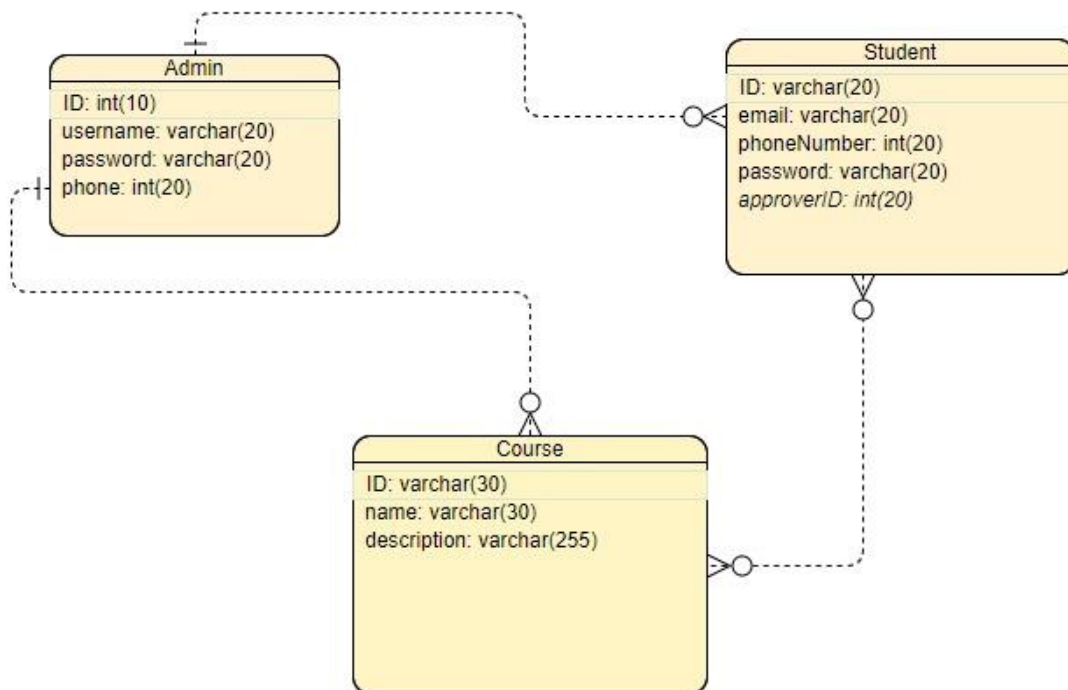


Figure 8 Entity Relationship Diagram

3.7.3 Physical Design

shows the actual input and output of the system. Sample pages

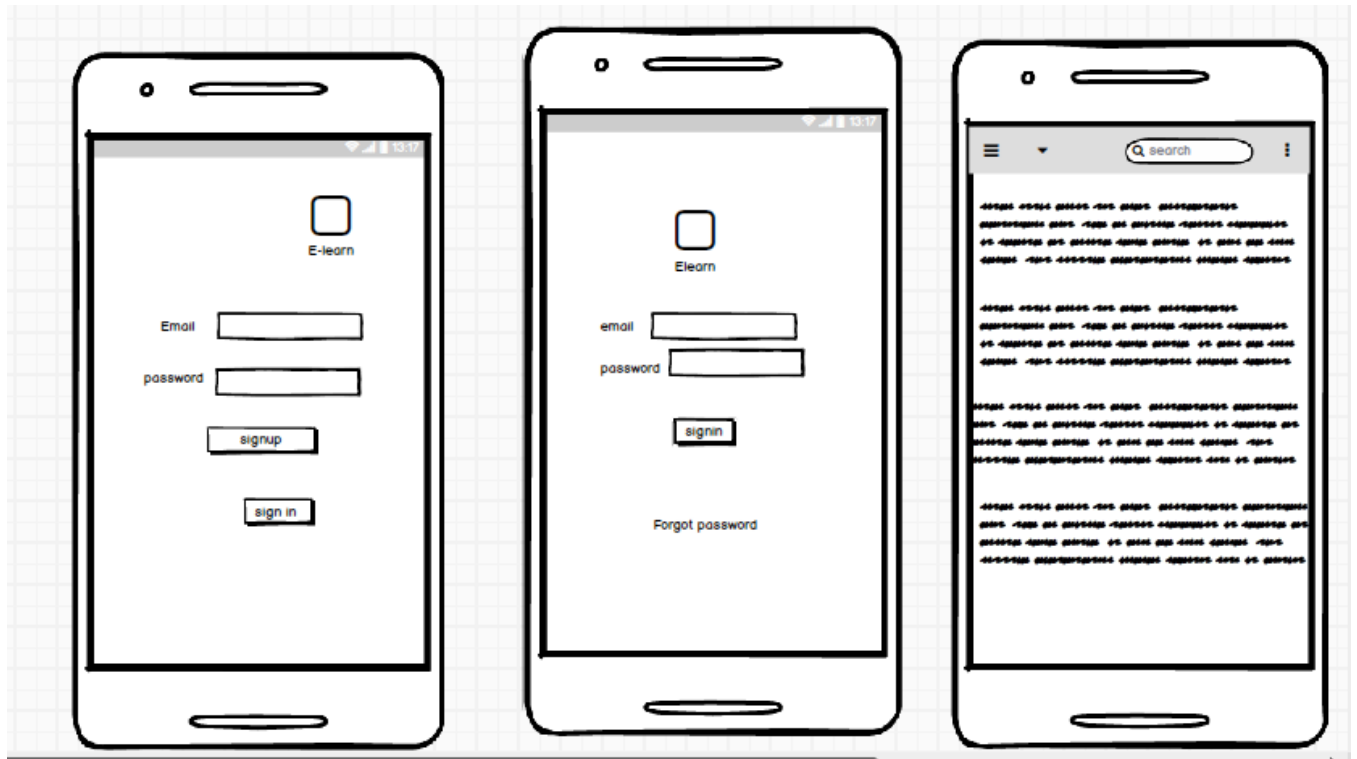


Figure 9 showing the home page,signup page and login page

Chapter 4

SYSTEM CODE GENERATION AND TESTING, CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

This chapter contains the sample code of the system in terms of functions and the various test plans that were carried out to make sure that the system was functioning as expected and undertaking the various activities in the correct manner. The chapter also contains the challenges faced during system development and the recommendations suggested.

4.2 Code generation

Below are sample codes that are contained in the system that represent then various functionalities

4.3 Development Tools

4.3.1 Android Software Development Kit

The Android Software Development Kit (SDK) is freely available and downloadable from Android's website. This SDK provides developers with the API libraries and tools necessary to build test and debug applications for Android. Several thing need to be considered before downloading and installing SDK, these include the checking for compatibility in terms of physical requirements.

4.3.2 Firebase

Firebase provides support for Android applications and other application such as web applications. Firebase also provides authentication with google services. Firebase helps power the application backend by providing data storage, providing user authentication, static hosting for the data such that it can be accessible everywhere. More the firebase real-time database provides Real-time information and data when there's change in the data stored

4.3.3 Testing Devices

The testing was done on an android device running on Android Operating system Android version 6.0

4.3.4 Storage Devices

There was need for project files transfer, this could be done using a flash disk, Hard Disk or a CD, and also for keeping back up files in case of the loss of the original copy. Other cloud storage applications are alternative, Google drive, or even GitHub.

4.3.6 Computer

A Personal computer that supports Android studio with a minimum RAM of 4GB, processing power 2.0 Ghz and greater and sufficient storage space for files storage.

4.3.7 Android Studio

An open source Integrated Development Environment (IDE) for Android application development, based on IntelliJ IDEA with powerful code editor and developer tools with assistance, Android Studio offers even more features that enhance your productivity when building Android apps.

4.3.8 Internet Browser

Used for the setup and configuration of Firebase console and viewing various items in the firebase backend such as authentication.

4.4 Development Languages

JAVA programming language was used for the development of the communication between different activities, while XML was used for the generation of the Graphical user interface.

4.5 Testing

Testing was done to determine whether the system was meeting the requirements, it was done after the system was put in place

4.5.1 Test plan

The Software Test Plan is designed to prescribe the scope, approach, resources, and schedule of all testing activities. The plan will identify items to be tested, the features to be tested, the types of testing carried out, the personnel responsible for testing, the resources and schedule required to complete testing.

Objectives of Testing

1. To achieve the correct code and ensure all Functional and Design requirements are implemented as specified in the documentation.
2. To provide a procedure for Unit and System Testing.
3. To identify the test methods for Unit and System Testing.

4.5.2 Test Results

GUI testing

This was done to ensure that first the navigation within the interface was easy and that the color used in the entire system and ensuring that the sequencing of events was proper and happened as specified.

Test case 1

Error generation

Expected outcomes:

Proper errors and warning with appropriate error and warning messages should be generated in the case that the user performs a wrong operation or an operation that transforms the database from one consistent state to another, for instance entering wrong password, and the errors generated should be in an appropriate color.

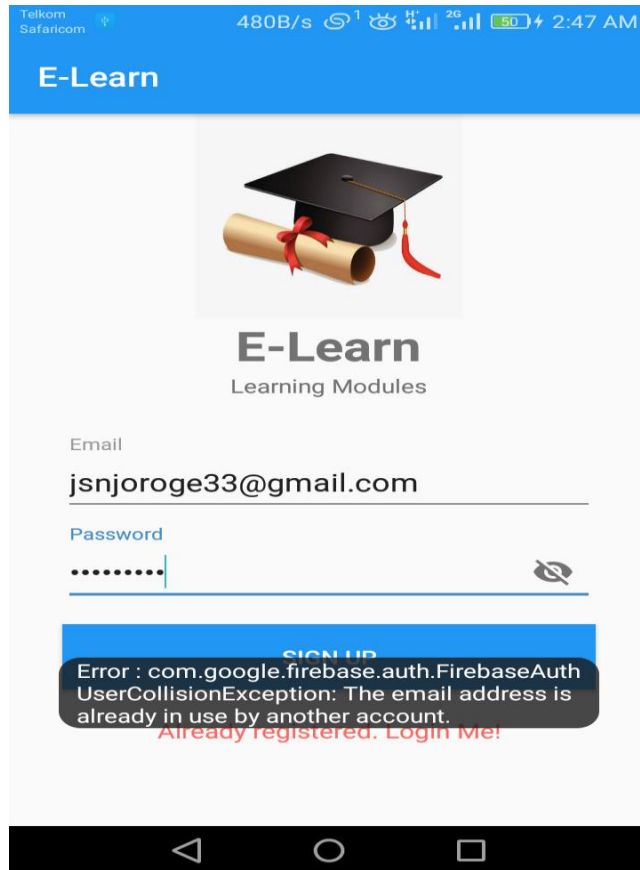


Figure 10 Error message generation

Actual outcomes:

Proper errors and warning were generated when the user performed a wrong operation and suggest the right action. The font of the generated errors was in the color red and a white for warnings.

Test case 2

Confirmation messages

Expected outcomes:

The user should receive confirmation messages that is some form of feedback on an action he or she carried out on the system for example successful log in.

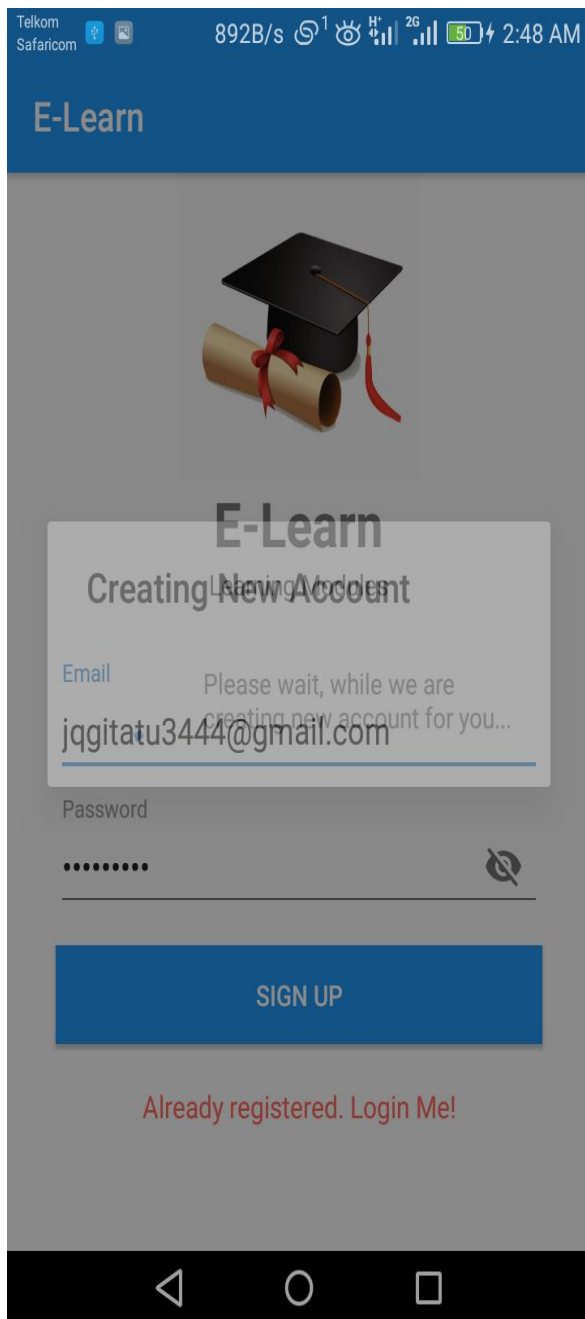


Figure 11 Confirmation Dialog

Actual outcomes:

Confirmation messages for all major operations are generated as some form of feedback to the user confirming their action.

Test case 3

Navigation Verification 1

Expected outcome

All links or buttons provided on the GUI should lead to the locations where they are really supposed to lead to, both internally and externally, and not wrong destinations.

Actual outcome:

All links or buttons on the GUI lead to the correct destinations and are working appropriately.

Navigation Verification 2

Expected outcome

Users should be able to view login credentials to confirm, if need be, that they have provided the correct details. They should also be able to view the same credentials, recover accounts after forgetting the password.

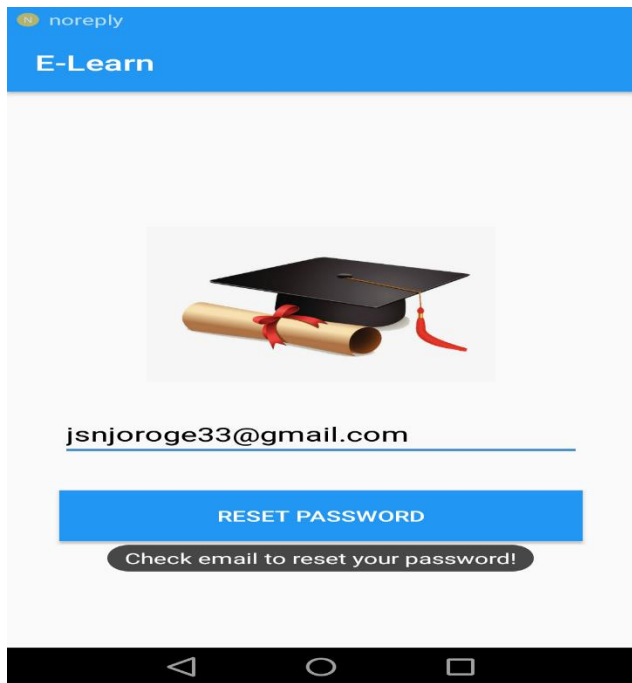


Figure 12 password reset

Actual outcome:

The users were able to:

- i. Recover account after forgetting passwords

- ii. Change credentials such as password

Module Testing

The modules in the interface were tested to ensure that information properly flowed and each task in the module was displayed as expected.

Type of Test	Area To be Tested	Given Result	Expected Results
Module Testing	Adding new user module (account registration)	The system interface was able to add new user into the system	The system interface should be able to add new users into the system
	Course display module	the interface displayed each unit together with relevant materials for that unit	The system interface should display each course unit and relevant notes of that unit.
	Search and give results module	The module was able to search and give results	The search button on the units page should display search result a user searches

Table 5 Module testing

Integration Testing

This is the testing was done to find out whether the various modules making up the system were able to work together and generate the expected results. This was also done to determine whether the client and the server interacted correctly.

Type of Testing	Area To be Tested	Given Results	Expected Results
Integration testing	The login, search, and give results	The system was able to display the various values and items in the database	The system shall be able to search, and give results

Table 6 Integration testing

Acceptance Testing

This was carried out to test the user acceptance of the system after completion of the system development and testing. It involved introducing the new system to the user and giving them the system performance.

Types of Test	Areas To be Tested	Given Results	Expected Results
User requirements	Finding out whether the system met the specified requirements specified by the user	The system was able to meet most of the given user requirements while others were much complex to achieve due to time factor and others will be recommended to be included in the future	The system should be able to meet a larger part of the requirements specified by the client while still creating room for additional requirements.
Black Box testing	Working of the internal structure and design	All internal components were able to communicate effectively	Efficient internal working structure

Table 7 Acceptance testing

Functional Testing

It's done to validate an application and ensure that the system performs all the expected functionalities correctly. It included testing of each function step by step of each module.

Type of test	Areas to be tested	Given results	Expected results
Functional testing	Entire system	All the deployed functions were able to perform and also interact with the modules contained in the system	All functions should perform and result to the expected outputs and the interaction between the various components.

Table 8 Functional Testing

4.6 Conclusion

Comparing the existing the existing web based system this system will provide extra materials for learning to students. I believe the system has met the predefined requirements thus able to perform its function well effectively and efficiently.

4.7 Limitations

During the process one of the problems, I encountered different displays that is the android studio emulator had a slightly differing display to that of the phone connected via a cable and had to redesign some pages.

4.8 Recommendations

For this research project, I would recommend additional of other features such as video tutorials to enhance training and learning.

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Appendices

Resource Requirement

The following resources are required for the implementation

Hardware

Phone

An android device running on Android Operating system that is higher than Android version 4.4.2 (KitKat) and with SDK version higher than 21. The device is preferable to have a display of a minimum 4.5 inches length.

Laptop

Laptop with the following specifications

1. Processor core i3
2. 4GB DDR3-1333 RAM
3. 320 GB hard drive
4. Operating system Windows 10 Pro

Software

1. Word processors - Microsoft office word for developing the proposal document.
2. Spreadsheet – Microsoft office Excel generating Gantt charts
3. Microsoft office Power Point for presentation purposes
4. Android studio
5. Firebase for application backend

Other Requirement

1. Stationery
2. Printing of the proposal document
3. Internet for research purposes

Budget and Budget Justification

Model number	Item definition	PRICE PER UNIT	NO. OF UNITS	TOTAL (KSH)
	laptop	0	1	0.00
HUAWEI E5573Cs-322	modem	5,400	1	5,400.00
	Word processor	0		0.00
	Ms project	0		0.00
	stationery	200		200.00
	printing	500		500.00
	Internet	1,000		1,000.00
				7,100.00

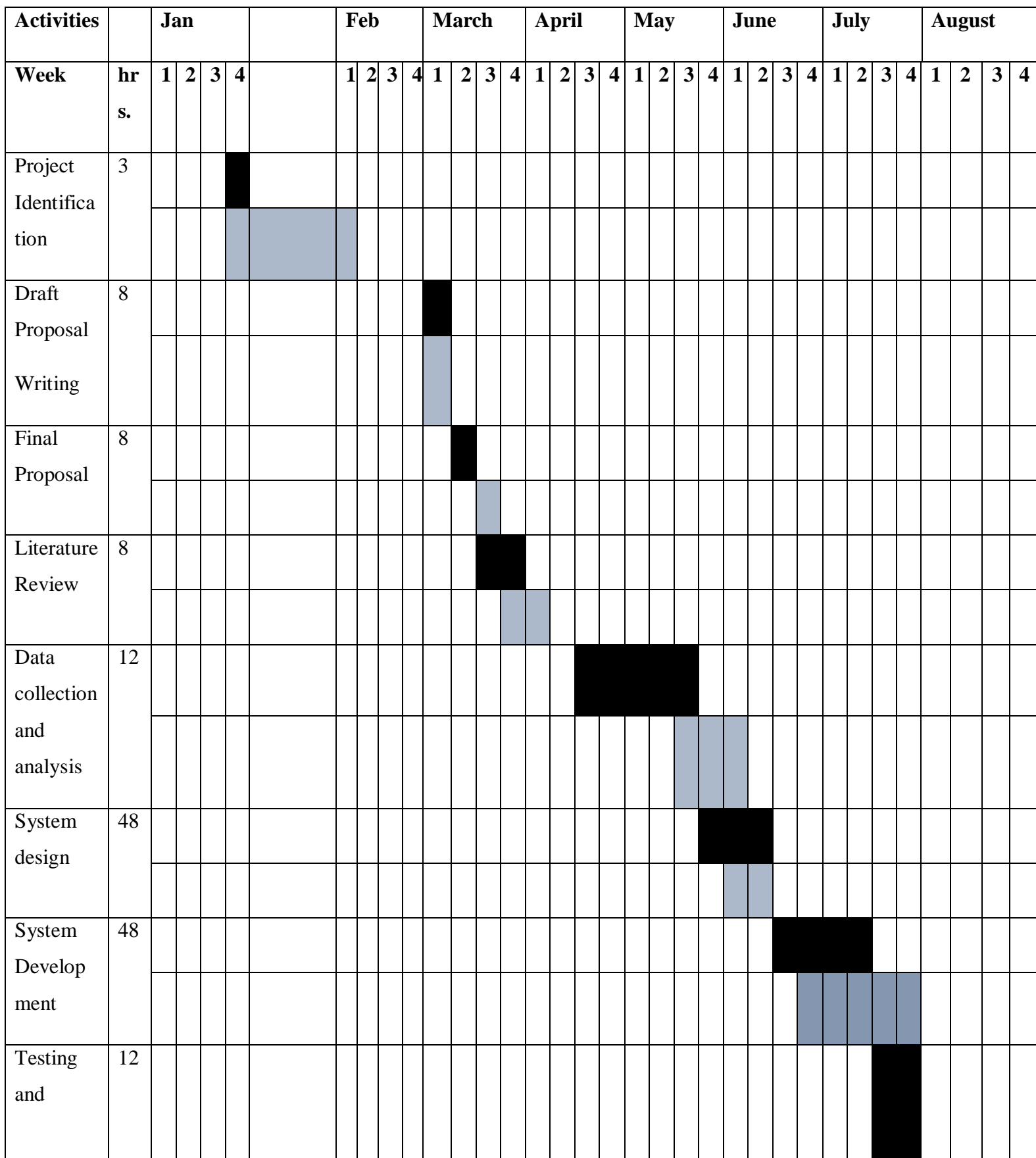
Table 9 budget and budget justification

Project Time Plan

	Description	Duration (Weeks)	Proposed Start date	Proposed Finish date	Actual Start Date	Actual Finish Date	Deliverables
1	Project Identification	2	7/1/19	11/1/19	14/1/19	28/1/19	Problem statement definition
2	Draft Proposal Writing	2	2/1/19	16/1/19	28/1/19	10/2/19	Draft Proposal
3	Final Proposal	2	12/1/19	28/1/19	10/2/19	12/2/19	Final Proposal
4	Literature Review	3	20/1/19	13/2/19	4/3/19	22/3/19	Literature review report
5	Data collection And analyses	4	20/2/19	14/3/19	25/3/2019	19/4/19	Requirements specification
7	System design	4	1/3/19	29/3/19	23/4/19	10/5/19	System design
8	System Development	6	10/3/19	28/4/19	23/4/19	12/7/19	Working System
9	Testing	3	1/5/19	21/5/19	15/7/19	26/7/19	Working System
10	Project Report	28	12/1/19	12/7/19	14/1/19		Project Report

Table 10 Project time plan

Gantt chart



[illegible]

Project Report	24																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Table 11 Gantt chart

Sample Code

Mainactivity.java code

```
package com.example.njoroapp;

import androidx.annotation.NonNull;

import androidx.appcompat.app.ActionBar;

import androidx.appcompat.app.AppCompatActivity;

import android.content.Intent;

import android.os.Bundle;

import android.text.TextUtils;

import android.view.Menu;

import android.view.MenuItem;

import android.widget.ListView;

import androidx.appcompat.widget.SearchView;

import com.google.firebase.auth.FirebaseAuth;
```

```

import com.google.firebase.auth.FirebaseAuth;

import java.util.ArrayList;

public class MainActivity extends AppCompatActivity {

    private FirebaseAuth firebaseAuth;

    private FirebaseAuth.AuthStateListener authStateListener;

    ListView listView;

    ListViewAdapter adapter;

    String[] title;

    String[] description;

    int[] icon;

    ArrayList<Model> arrayList = new ArrayList<Model>();

    @Override

    protected void onCreate(Bundle savedInstanceState) {

        super.onCreate(savedInstanceState);

        setContentView(R.layout.activity_main);

        firebaseAuth = FirebaseAuth.getInstance();

        authStateListener = new FirebaseAuth.AuthStateListener() {

            @Override

            public void onAuthStateChanged(@NonNull FirebaseAuth firebaseAuth) {

                FirebaseAuth user = firebaseAuth.getCurrentUser();

                if(user == null){

```



```

        startActivity(new Intent(getApplicationContext(), Sign.class));

        finish();

    }

}

};

listView = findViewById(R.id.listView);

for (int i = 0; i < title.length; i++) {

    Model model = new Model(title[i], description[i], icon[i]);

    //bind all strings in an array

    arrayList.add(model);

}

//pass results to listViewAdapter class

adapter = new ListViewAdapter(this, arrayList);

//bind the adapter to the listview

listView.setAdapter(adapter);

}

```

@Override

```

public boolean onCreateOptionsMenu(Menu menu) {

    getMenuInflater().inflate(R.menu.main, menu);

    MenuItem myActionMenuItem = menu.findItem(R.id.action_search);

```

```

SearchView searchView = (SearchView) myActionMenuItem.getActionView();

searchView.setOnQueryTextListener(new SearchView.OnQueryTextListener() {

    @Override

    public boolean onQueryTextSubmit(String s) {

        return false;

    }

    @Override

    public boolean onQueryTextChange(String s) {

        if (TextUtils.isEmpty(s)) {

            adapter.filter("");

            listView.clearTextFilter();

        } else {

            adapter.filter(s);

        }

        return true;

    }

});

return true;

}

@Override

public boolean onOptionsItemSelected(MenuItem item) {

    switch (item.getItemId()) {

```

```

        case R.id.about:

            about();

            return true;

        case R.id.log_out:

            icon = new int[]{R.mipmap.logout};

            option_logout();

            return true;

        default:

            return super.onOptionsItemSelected(item);

    }

}

public void about() {

}

public void option_logout() {

    icon = new int[]{R.mipmap.logout};

    firebaseAuth.getInstance().signOut();

    finish();

    startActivity( new Intent(getApplicationContext(),Sign.class)) ;

}

@Override

protected void onStart() {

```

```

        super.onStart();

        firebaseAuth.addAuthStateListener(authStateListener);
    }

    @Override

    protected void onStop() {

        super.onStop();

        if(authStateListener!=null){

            firebaseAuth.removeAuthStateListener(authStateListener);

        }

    }

}

```

Screen Shots of Modules Tested

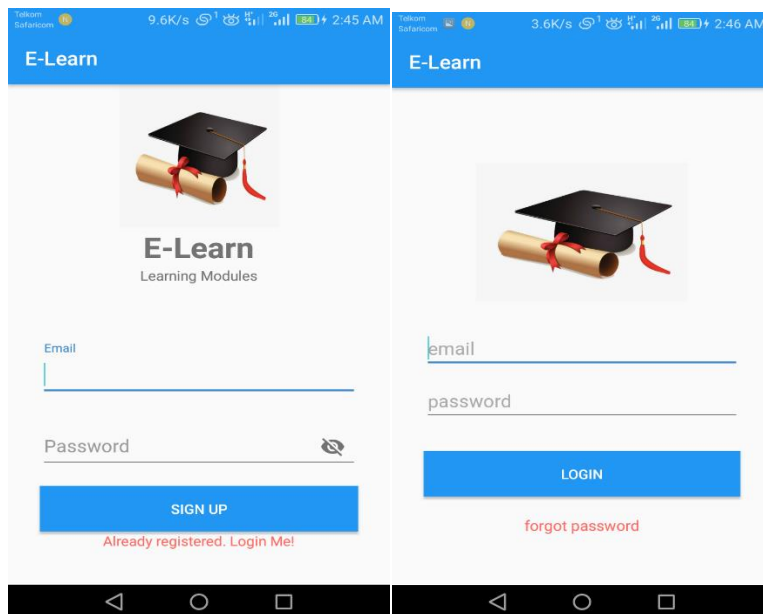


Figure 13 signup and login pages

Screen shot shows signup and login using email and password

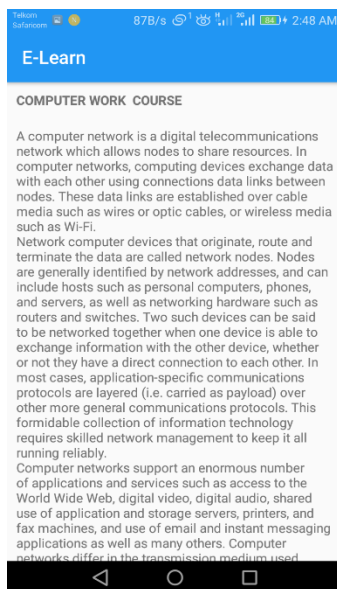
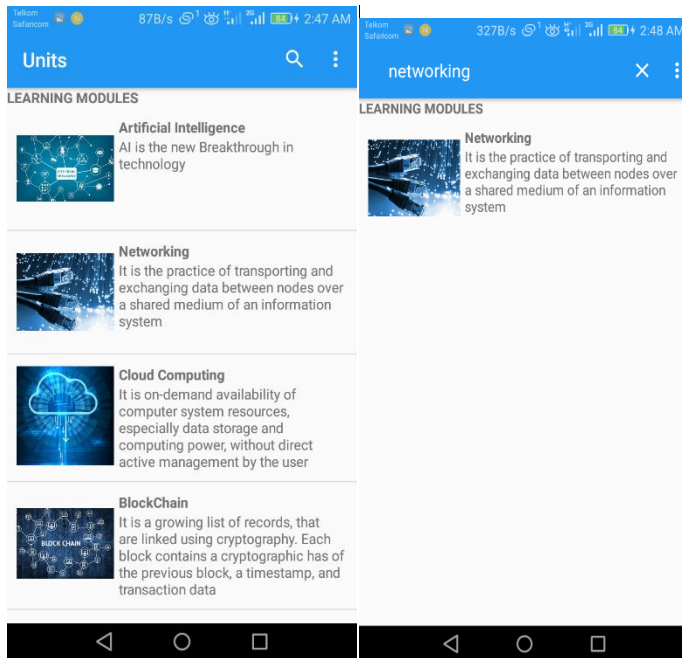


Figure 14 Course home page and courses

Sample Questionnaire

I am James Njoroge Njuguna from Jomo Kenyatta University of Agriculture and Technology. If it is not too much trouble take a couple of minutes to express your conclusions on the underneath inquiries. Your answers are essential to the accomplishment of this examination. Please answer with 'YES or NO' where required. This is the poll is aimed at getting opinion on development of a mobile based interface for e-learning

a) What's your gender? Male ☐ Female ☐

b) Are you a student? YES ☐ NO ☐

c) If yes, which mode of study do you use?

Full-Time/Regular Day ☐

Evening ☐

Weekend /Part-Time ☐

Distance Learning ☐

d) Are you a Jomo Kenyatta University of Agriculture and Technology student?

YES ☐ NO ☐

e) Have you used the SODEL e-Learning system?

YES ☐ NO ☐

f) Challenges faced when using the web based e-learning system?

g) Do you find the system effective? YES ☐ NO ☐ NOT SURE ☐

If NO, what recommendations would you give?

h) would you recommend a mobile application for SODeL?

YES ☐ NO ☐ NOT SURE ☐

Thank you for agreeing to take part in this survey. All of the answers you provide in this survey will be kept confidential. No identifying information will be provided to the public. The survey data will be reported in a summary fashion only and will not identify any individual person.