



Towards a Robust Mobile Learning Framework for Nigerian Higher Institutions Using a Hybrid System

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Article Info

Keywords:

Android, Mobile learning, Robust, Smart Phones, Web application

Received 18 April 2021

Revised 01 May 2021

Accepted 07 May 2021

Available online 04 June 2021



<https://doi.org/10.37933/nipes/3.2.2021.19>

<https://nipesjournals.org.ng>

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Abstract

Off-site or online education is yet to be fully adopted in most Nigerian higher institutions especially the public ones. Some of the few institutions that embrace this trend depend on some third party platforms. Meanwhile, due to the dominance and popularity of Android devices which have grown drastically in our society and among students of higher institutions, application development on an Android based platform is a perfect way to reach out to millions of them. This paper presents a robust design involving the hybrid of a web based application and an Android application. The webbased part supports the admin panel involving the administrator's activities such as set quiz, add department, add course/topic/material, add and remove questions, manage score, add and remove courses whereas the Android based part primarily supports students' activities involving viewing and learning such as login, register, select department, select course/topic/material, take quiz and others. Some of the resources adopted in this work include Android studio, Wamp server, HTML, java and PHP. This framework was implemented using the Federal Polytechnic Ile-Oluji, being a Nigerian higher institution. The typical database design, Android application design and the Website design are clearly shown in the work. The system tends towards the provision of a ubiquitous learning mood for students.

1. Introduction

Online activities are now taking over all around the world, meetings, lectures, counseling, conversations are effectively held online. The academia can also be more integrated into online activities. For few years now, there has been great emphasis on how mobile technologies can enable the achievement of Education for All. This concept has started to be implemented by UNESCO in some of the developing countries of the world. In central Nigeria, a mobile application to help English language teachers improve the language literacy skills among the primary school students has been developed. In Senegal, UNESCO has also launched a mobile learning application to support student learning in mathematics. There have been similar projects by UNESCO in Pakistan and Mexico. Electronic learning is becoming a major solution to education. [1], [2], [3], [4]. More specifically, MOBILE learning is therefore turning out to be one of the solutions to the challenges faced by education worldwide [5], [6].

According to Mobile operating system market share worldwide of 2018, Android Mobile Operating system leads by 76.61%, Apple's IOS comes second by 20.66% followed by KaiOS 0.56%, Windows 0.37% and Lastly Samsung with 0.27%. The academic environment alone cannot meet the growing academic needs we have today. These days, there is need to be online and offline to achieve work efficiency. Students need to be regularly assessed on each topic taught in the class, this is because many students tend to forget what is being taught in class overtime especially for those who do not review their notes after each lecture. Many youths and students become addicted to phones because of the unending technologies and applications that Android can accommodate. Meanwhile, internet accessibility and affordability is often a huge challenge for most Nigerians. This does not exempt the students of higher institutions. The design of a robust and ubiquitous mobile learning application that will help to catch more interest of the students of higher institutions in the aspect of learning is essential. In other words, an application that will be able to work on their commonest devices despite the varying internet accessibility is of vital interest -a ubiquitous and robust application. This work tends to create a robust Android Mobile Learning application system using the Federal Polytechnic Ile-Oluji, Nigeria as a case study.

2. Related Works

Many authors have published related articles that could enhance learning. [7] presented an adaptive content delivery in ubiquitous learning environment that is very good for multiple forms of learning. Several platforms are being developed to provide flexible system of learning. Some are adaptive systems that tend to mimic some existing scenarios in the environment while some are integrative trying to integrate several platforms. For example, [8] presented mobile application system which includes web services implementation just like [9] focused on an approach to personalization by integrating e-learning and m-learning. Similarly, [10] attempted to integrate project based learning environment into the designing and developing of mobile applications for learning 2D animations. This can be used basically for effective learning of 2D. [11] also proposed Android Mobile augmented reality application based on different learning theories which can be used on platforms though basically for primary school children. The role of mobile learning in the future of e-learning is germane especially in Africa [12]. So, this paper focuses on a ubiquitous and robust mobile application suitable for Nigerian Higher Institution.

2.1 M-learning

The special thing about learning through mobile devices over other types of learning is that learners can be constantly in motion. [13] opined on the advantage of m-learning as it is possible to take ideas and learning resources from any place and to apply or develop them in another place sometime thereafter. So that the knowledge gained at one time can be used later, or perhaps even in a different context of learning.

Also, it is possible to move from one learning object to another, as well as manage a number of different learning objects, without necessarily following a uniform program of studies. The use of technological devices can be used as fit. For example, one can choose when to use the mobile phone depending on his or her needs.

Learning through mobile devices does not try to separate learning from other forms of educational activity, as some aspects of informal learning and learning that takes place in workplaces are fully movable. Even students within a school will move from a class to another class and from a topic to another topic.

So, the subject of interest in learning through mobile devices is how knowledge and skills can be transferred e.g. from home to school and vice versa, how learning through mobile devices at different times of man's life can be managed and how new technologies can support a human society in which people are increasingly constantly on the move. People can learn through mobile devices in more and more situations of their daily life. Studies show that, interest-wise, only 1% of learning occurs during someone's movement. It seems that existing technology cannot adequately support learning during someone's movement. According to [14], there may be opportunities to design a new technology which can support learning during the ever-increasing time when people travel, or namely are "in motion". Also, more and more people, especially young people, possess one or more "smart" mobile devices. This should be particularly taken into consideration when investing in a new learning generation, more innovative and modern, which will take mobile devices into account.

It should be taken into consideration that mobile phones give the opportunity to not only make phone calls, but offer additional benefits through their supported services, such as sending and receiving text (SMS) or multimedia messages (MMS). So now we see a convergence of mobile technologies, in functions that combine phone, camera and wireless multimedia computer. Another equally significant convergence occurs between new mobile technologies and new concepts of lifelong learning.

There is a suggestion that the theory of m-learning must be tested against the following criteria [13]:

- i. Is it significantly different from current theories of classroom, workplace or lifelong learning?
- ii. Does it account for the mobility of learners?
- iii. Does it cover both formal and informal learning?
- iv. Does it theorize learning as a constructive and social process?
- v. Does it analyze learning as a personal and situated activity mediated by technology?

2.2 Application Package Interface (API)

API Level is an integer value that uniquely identifies the framework API revision offered by a version of the Android platform. There are various versions of android with their respective version code as well as the API levels. The Android platform provides a framework API that applications can use to interact with the underlying Android system. The framework API consists of:

- i. A core set of packages and class
- ii. A set of XML elements and attributes for declaring a manifest file
- iii. A set of XML elements and attributes for declaring and accessing resources
- iv. A set of Intents
- v. A set of permissions that applications can request, as well as permission enforcements included in the system
- vi. The API Level identifier serves a key role in ensuring the best possible experience for users and application developers:
- vii. It lets the Android platform describe the maximum framework API revision that it supports.
- viii. It lets applications describe the framework API revision that they require
- ix. It lets the system negotiate the installation of applications on the user's device, such that version-incompatible applications are not installed.

2.3 Android

The name Android is coined from the Greek word and r-, the meaning of which is “man”, and the suffix ‘-oid’, the meaning of which is “of the species”, so Android means as much as “being human” [15].

Android is a complete, open and free platform, designed primarily for touch screen mobile phones, such as smart phones and tablet computers. It was founded way back in 2003, it was developed by Andy Rubin, Rich Miner, Nick Sears and Chris White, in Palo Alto, California and it was purchased by Google in August, 2005.

Android includes an operating system which is based on the free Linux kernel, the necessary middle-ware, libraries and key mobile applications. The description of the most important components of Android include: (i) Linux Kernel (ii) Android runtime (iii) Application Framework and (iv) Applications [16]. Android based application is suitable for learning as recommended by several authors [17], [18], [19], [20]. Android based applications can be flexible and user-friendly e-learning applications suitable for mobile devices [21], [22], [23], [24].

3. Methodology

3.1 Design Analysis

The entire blueprint of this project design is illustrated in Figure 1. The model helps to show the basic aspect and functioning of the project work. The diagram shows three rectangular boxes which individually represent the students, database and administrator. The students activities are all enclosed in the Android Application and the administrator activities are carried out on the web application. The oval shapes represents the activities carried out by the students and administrator, this is shown by matching the user with single headed arrow lines. These activities are connected with the database center rectangular box, as shown in the diagram, the database connects with the activities using a double headed arrow line, and this explains the communication between the database and the activities.

3.2 Selection of Materials

Certain resources are essential for the development of this system and the following were carefully selected for various purposes ranging from backend to frontend: Windows 10, Java development Kit (JDK) 8, Android Studio, Android SDK, My-SQL data base, PHP, Wampserver, Java and Extended Markup Language.

3.3 Design procedures

The system design gives detailed information about how the application works with the aid of diagrams and charts such as Flowchart. The design will help to analyze the system working principles. Different aspects of the application will be treated separately, such as login design, forget password, user menu design and others. The system is divided into two parts, the web based part for admin login and the android login for the students. Some of the features of the web based admin page includes: admin login page, settings page and change of password, add department page, list department page, add quiz page, list quiz, add course page, list quiz, manage scores page, and logout

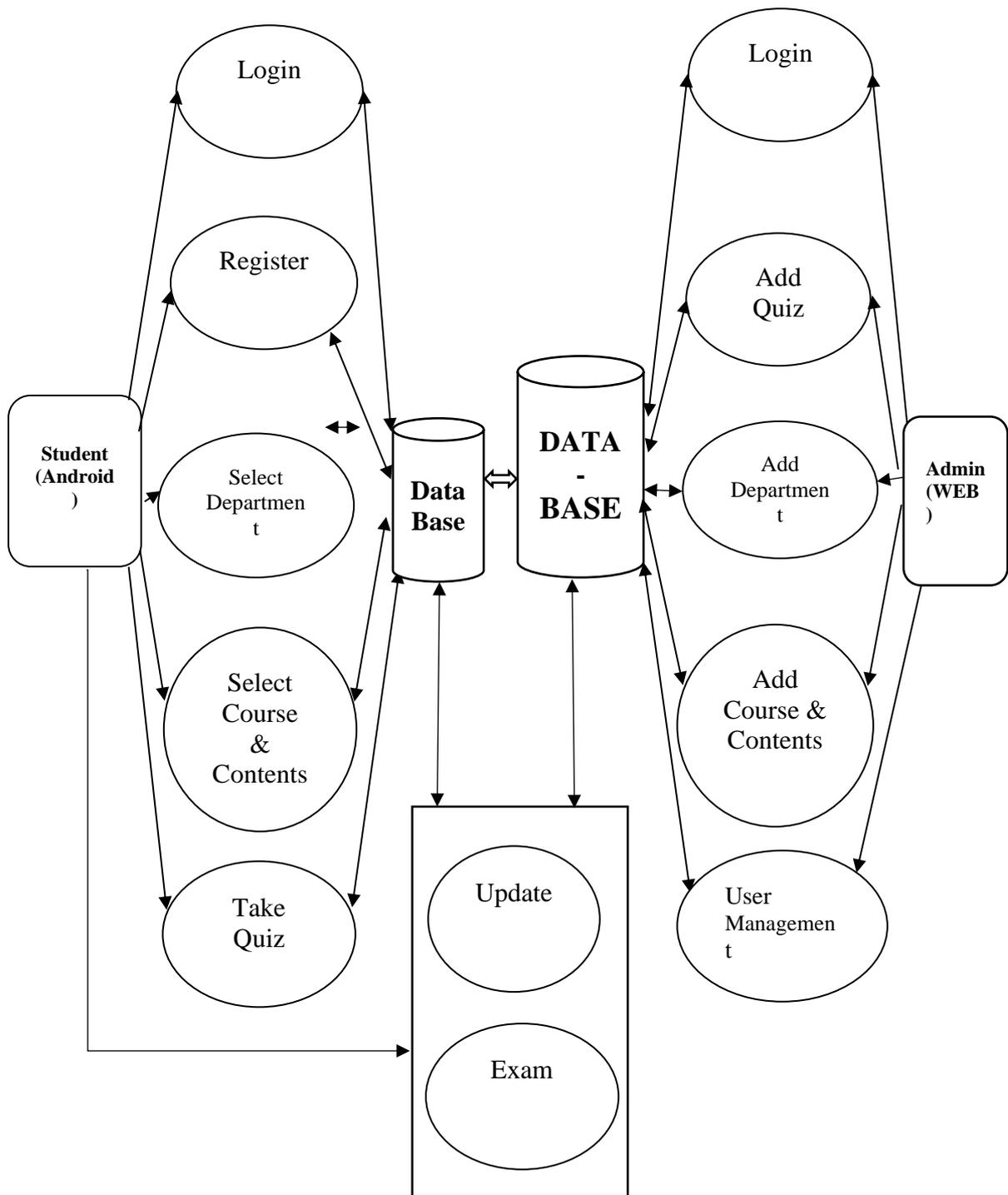


Figure 1: Design Model

3.3.1 Admin login

The Admin login page takes in the admin password and email address to login, if the login is successful, it takes the admin to the home page and if unsuccessful, it will require for the correct login details. The flow chart for the login page is shown in Figure 2.

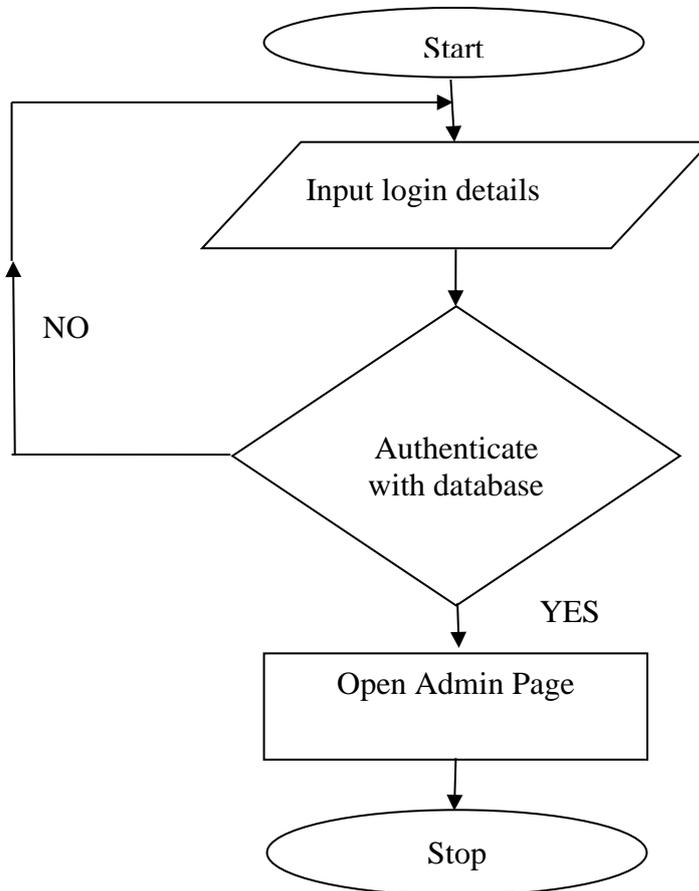


Figure 2: Flowchart design for Admin Login

3.3.2 Change password

The change password menu requires the old password to be logged in to authenticate with the current password in the database. The change password page was designed to help in account security for the admin. The change password page can be accessed by clicking on the settings tab on the homepage. The flowchart for change of password is shown in Figure 3.

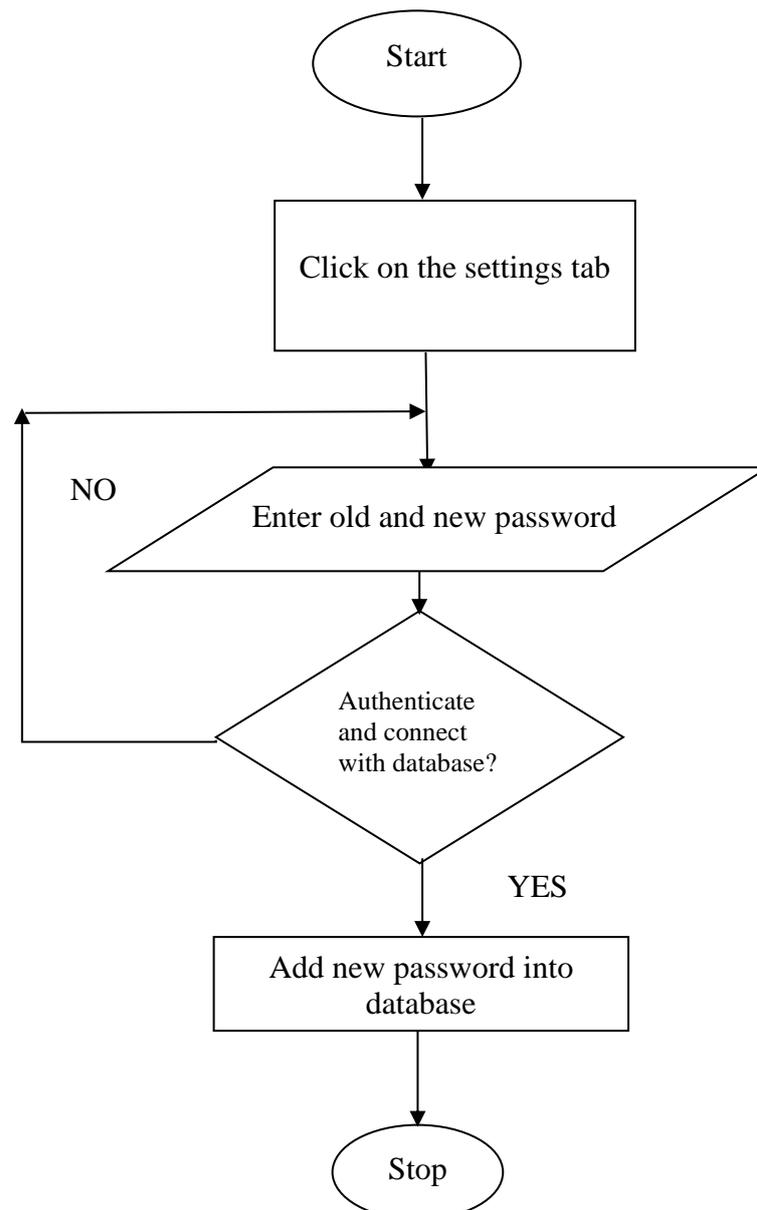


Figure 3: Change of password flowchart

4. Results and Discussion

4.1 Performance Test

The system was tested on several computers which worked effectively. The Android application has been tested on several mobile phones of the required Android versions and also on the computer emulator. For an effective performance of the Android application, the latest version of Android Studio should be used to run the application, this should be done by connecting to the internet for downloading the necessary packages needed from the Android SDK for the first time of running the application. For publishing purpose the database should be hosted on an online server for effective and public use.

4.2 Presentation and Discussion of Results

The results of this project are in three phases which are the web admin panel design, the database design and Android application design, they can be found in subsections 4.2.1, 4.2.2 and 4.2.3 respectively.

4.2.1 Web admin panel design

The design aspect of the project with their respective description and the pages included are shown in this section.

I Admin login page

The Admin login page takes in the admin password and email address to login, if the login is successful, it takes the admin to the home page and if unsuccessful, it will require for the correct login details. The Admin login page is shown in Figure 4.

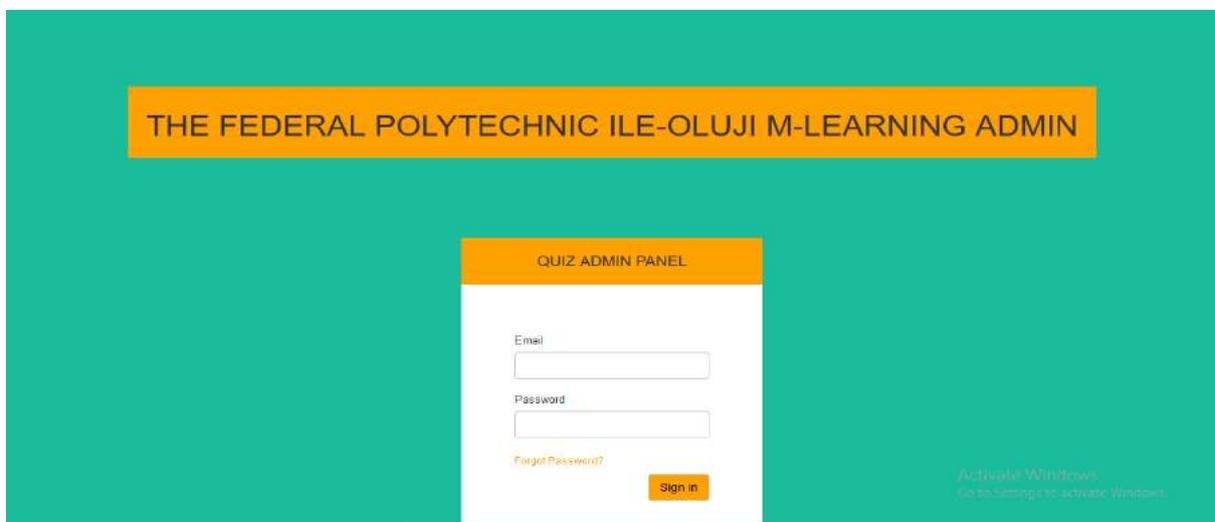


Figure 4: Admin login page

II. Home page

The homepage is the first major page of the website that gives proper architectural coherence and links to other websites, some links includes, official school website, department access, course access, questions assess, user management, etc. The diagram is shown in Figure 5.

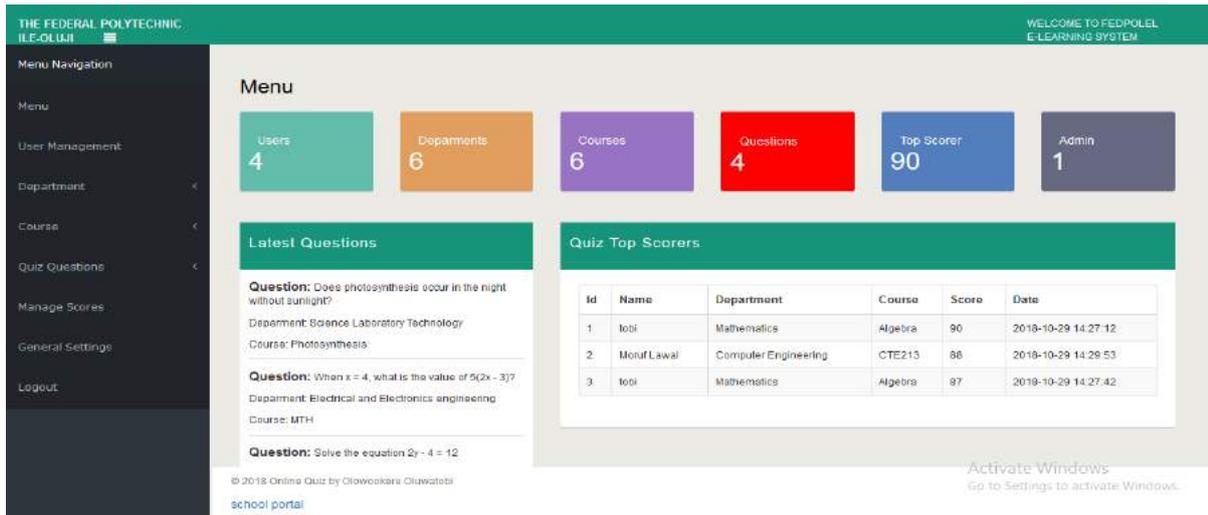


Figure 5: Home page

III. Department list page:

The department list page helps to list the departments in the Polytechnic; it can be accessed from the department tab under the Menu, then click department list. The department list comes along with the faculty the department belongs to, the department logo, and a department can also be added or removed here. The diagram for the department list page is shown in Figure 6.

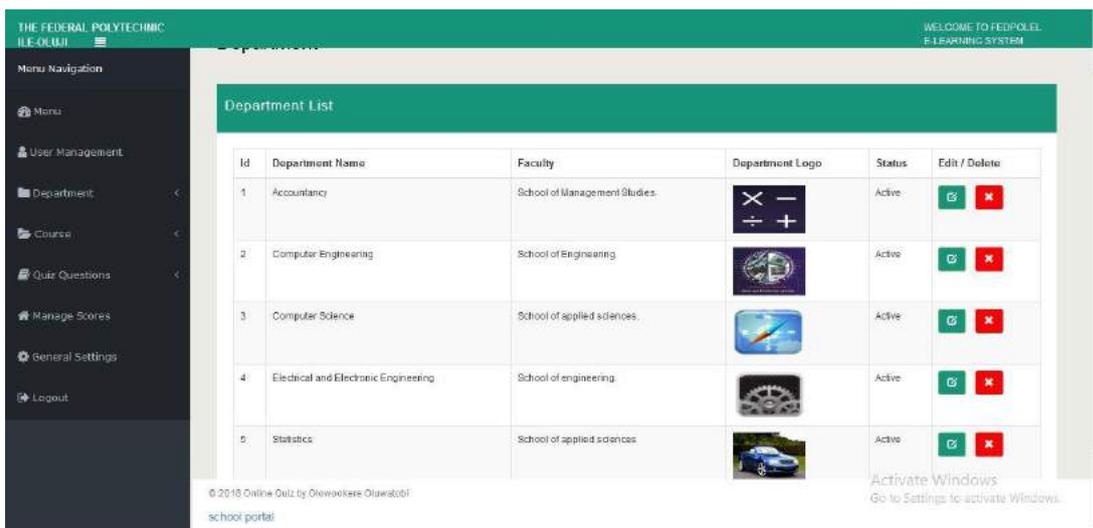


Figure 6: Department List page

IV. User management page

The department list page can be used to edit, delete and manage student accounts, students email and name can be edited by the admin, but a student cannot be added directly in the web panel, It can either be done by adding students in the database or registering on the application. The diagram of the user management page is shown in Figure 7.

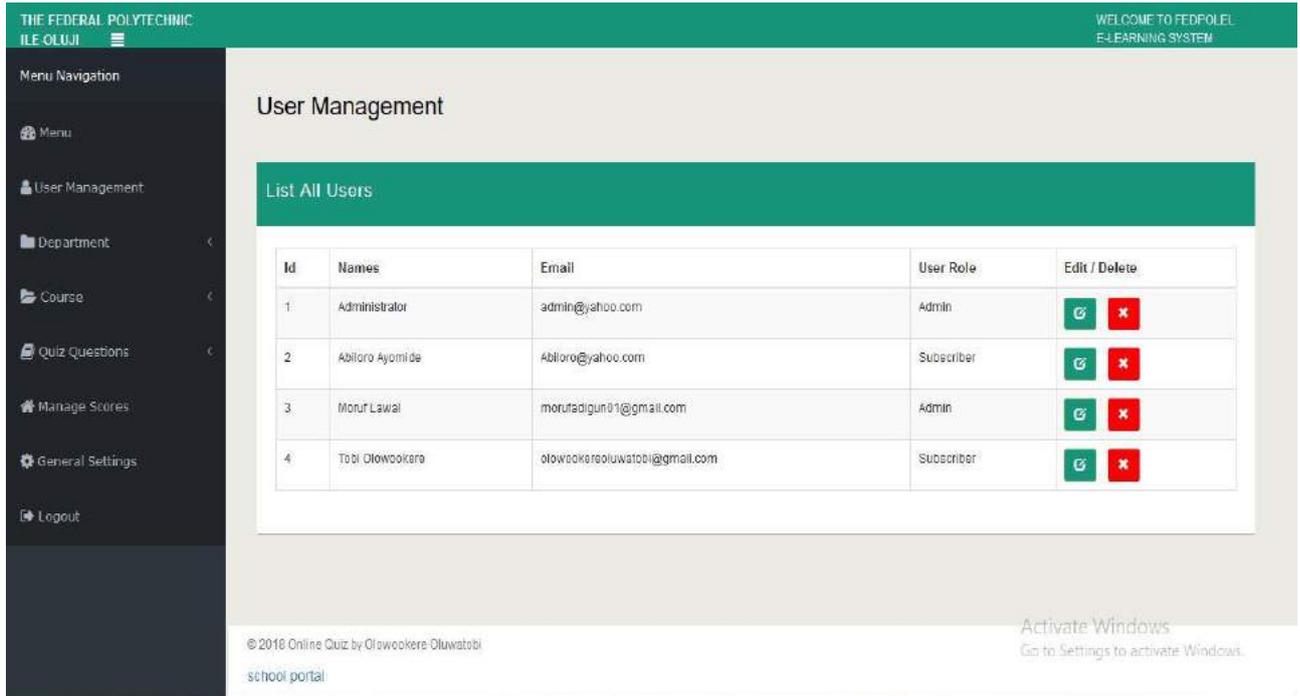


Figure 7: User Management Page

V Change Password Page

The change password page can be used to change admin password, this can be done in case if there is a suspected security breach. The change password menu requires the old password to be logged in to authenticate with the current password in the database. The change password page was designed to help in account security for the admin. The change password page can be accessed by clicking on the settings tab on the homepage. The flowchart for change of password is shown in Figure 8.

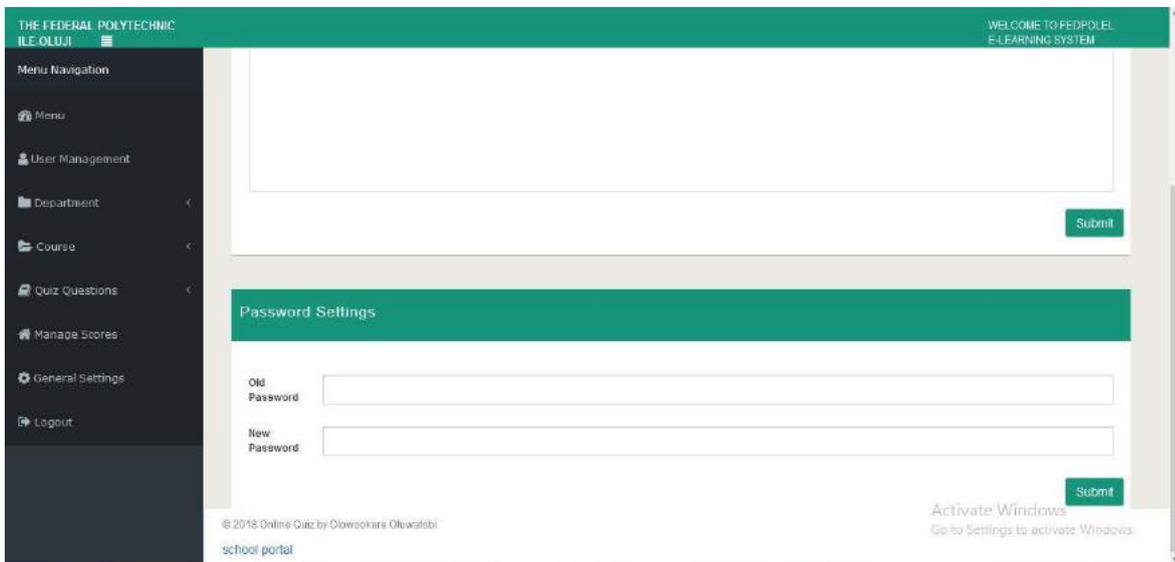


Figure 8: Change password page

VI Add New Course Page

To add a new course, there is need to add the department, course name, course outline/explanation, image (optional), course status. The courses can be added and updated as newer questions comes in. The figure for the Add New Course Page is shown in Figure 9.

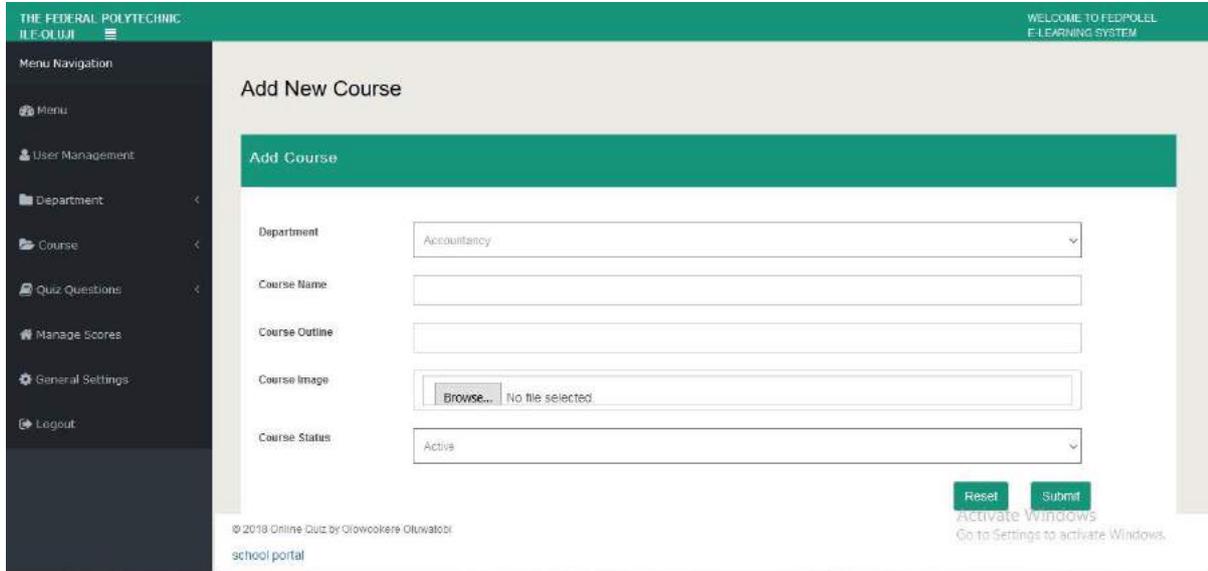


Figure 9: Add New Course Page

4.2.2 Database Design

The database design consists of five tables, Quiz Category (Department), Quiz subcategory (course), Quiz questions (Questions), users (students and administrator).

I. Department Table

This is where the departmental details are stored including the department name, courses, logo display and so on as indicated in Figure 10

id	name	description	image	status	created_at	updated_at
1	Accountancy	School of Management Studies	images/uploads/maths.jpg	1	2018-10-28 21:24:54.000000	2018-10-28 21:24:54.000000
2	Computer Engineering	School of Engineering	images/uploads/WA00ME8.jpg	1	2018-10-27 22:06:08.000000	2018-10-27 22:06:08.000000
3	Computer Science	School of applied sciences	images/uploads/knowledge.png	1	2018-10-27 21:53:41.000000	2018-10-27 21:53:41.000000
4	Electrical and Electronic Engineering	School of engineering	images/uploads/engineering.png	1	2018-10-27 21:53:41.000000	2018-10-27 21:53:41.000000
5	Statistics	School of applied sciences	images/uploads/carane.jpg	1	2018-10-27 21:53:41.000000	2018-10-27 21:53:41.000000
6	Science Laboratory Technology	School of applied sciences	images/uploads/IMG-20180529-WA0012.jpg	1	2018-10-27 23:09:04.000000	2018-10-27 23:09:04.000000

Figure 10: Department table

II. Course Table

This consists of the department name, course name, course description, Logo, etc. The diagram for this can be found in Figure 11.

The screenshot shows the phpMyAdmin interface for the 'quiz_group' table. The table contains the following data:

id	category	name	description	image	status	created_at	updated_at
1	Accountancy	Cost Accounting	This used to analyze cost and records	images/uploads/maths.jpg	1	2018-10-29 12:58:55.000000	2018-10-29 12:58:55.000000
2	Electrical and Electronic Engineering	MTH	Algebra is one of the broad parts of mathematics, ...	images/uploads/secured.png	1	2018-10-29 12:59:11.000000	2018-10-29 12:59:11.000000
3	Computer Engineering	MTH	Matrix definition, something that constitutes the ...	images/uploads/photo.png	1	2018-10-29 12:59:38.000000	2018-10-29 12:59:38.000000
4	Computer Engineering	CTE213	Operating System	images/uploads/equation.png	1	2018-10-29 13:00:17.000000	2018-10-29 13:00:17.000000
5	Science Laboratory Technology	SLT201	Plant research	images/uploads/geometry.png	1	2018-10-29 13:00:53.000000	2018-10-29 13:00:53.000000
6	Statistics	STA110	Prmbability is the measure of the likelihood that ...	images/uploads/probability.png	1	2017-07-03 01:03:47.000000	2018-10-29 06:56:14.000000

Figure 11: Course database table

III Score table

This consists of the department name, course name, email, password, and score. This can be used to evaluate users' score. The diagram can be found in Figure 12.

The screenshot shows the phpMyAdmin interface for the 'quiz_score' table. The table contains the following data:

id	category	subcategory	username	email	score	time_taken	created_at	updated_at
6	Computer Engineering	CTE213	Moruf Lawal	morufadigun01@gmail.com	88	30	2018-10-29 14:29:53.000000	2018-10-29 14:29:53.000000
6	Mathematics	Algebra	tobi	olowookereoluwatobi@gmail.com	90	30	2018-10-29 14:27:12.000000	2018-10-29 14:27:12.000000
7	Mathematics	Algebra	tobi	olowookereoluwatobi@gmail.com	87	35	2018-10-29 14:27:42.000000	2018-10-29 14:27:42.000000

Figure 12: Quiz Score Table

4.2.3 Mobile Application Design

The mobile application was designed to be accessible by students registered in the database, it also allows new students to register into the application, be demanding for their email address, password and username, the application is designed basically for students' activities alone, such as, take quiz, manage account, preference setting. The application has several activities/interface.

I. Intro activities

These are the first set of activities to be seen when the application is opened, and they give brief information about what the app is all about to the users. These activities are three in number and can be found in Figures 13(a), 13(b) and 13(c).

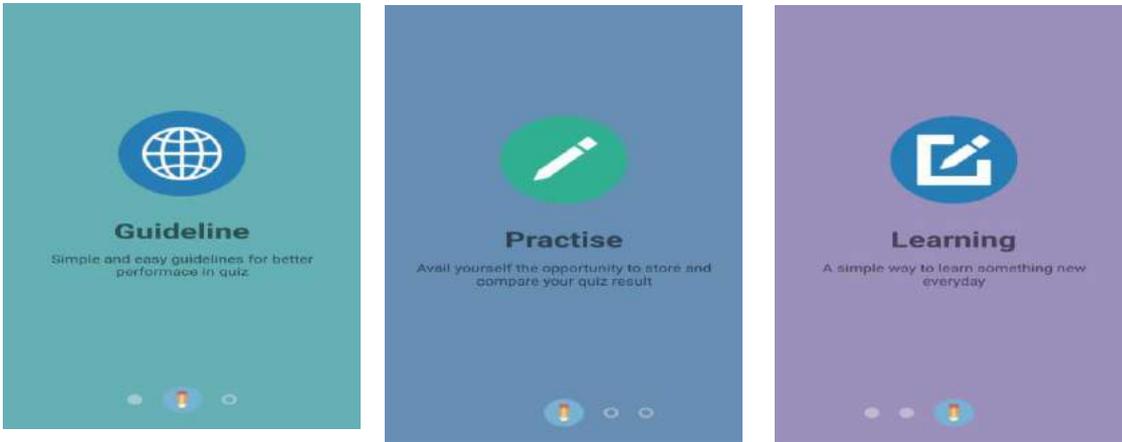


Figure 13(a): Intro activity Figure 13(b): Intro activity Figure 13(c): Intro activity

II. Student Login activity

The student login activity is the interface basically set aside for users to login into the application, it takes in the user password and email address, and also links to the student sign up activity. The diagram for this can be found in Figure 14.

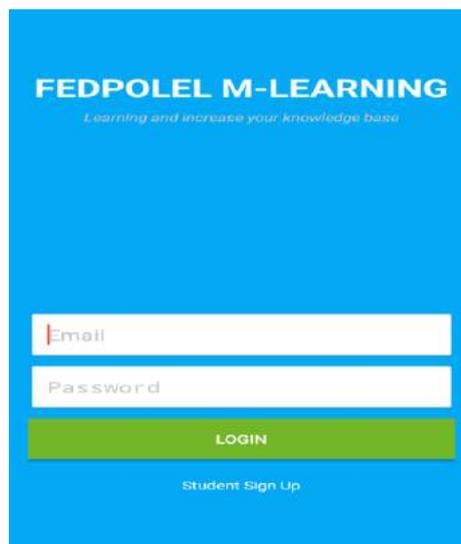
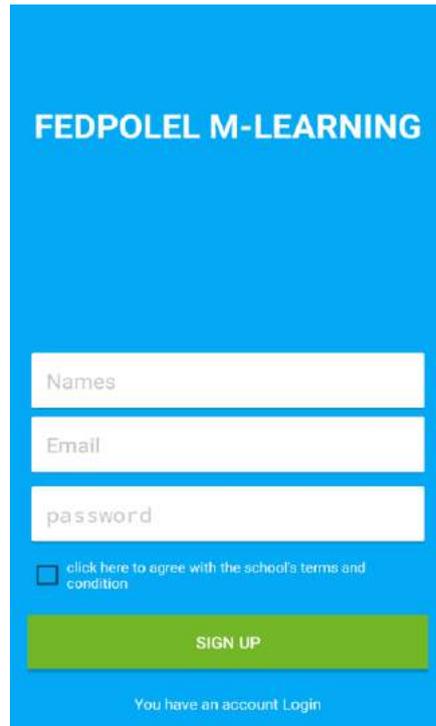


Figure 14: Student Login activity

III. Student Registration Activity

The image can be found in Figure 15 and its major benefit is to allow new students/user to register their details into the application to enable them to login and make use of the application.

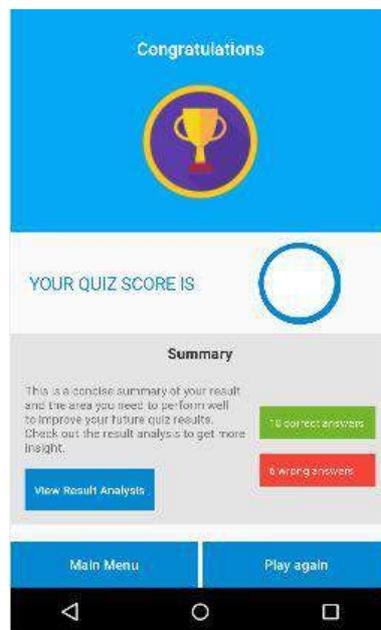


The image shows a registration form for 'FEDPOLEL M-LEARNING'. The form is set against a blue background. It contains the following elements: a title 'FEDPOLEL M-LEARNING' in white text; three input fields for 'Names', 'Email', and 'password'; a checkbox with the text 'click here to agree with the school's terms and condition'; a green 'SIGN UP' button; and a link 'You have an account Login' at the bottom.

Figure 15: Student Registration activity

III. Quiz Score activity

The Quiz Score activity is basically for the purpose of analyzing quiz score after some set of quiz has been taken, it views the total scores, total correctly answered question and total incorrectly answered question. This activity interface can be found in Figure 16.



The image shows the 'Quiz Score activity' interface. It features a blue header with the word 'Congratulations' and a trophy icon. Below this is a white section with the text 'YOUR QUIZ SCORE IS' and a circular progress indicator. A grey 'Summary' section follows, containing a paragraph of text and two buttons: '10 correct answers' (green) and '5 wrong answers' (red). At the bottom, there are two buttons: 'View Result Analysis' (blue) and 'Play again' (blue). The interface is displayed on a mobile device, as indicated by the Android navigation bar at the bottom.

Figure 16: Quiz Score activity

5. Conclusion

The non-availability of constant and reliable internet access for students, which is a key factor militating against efficient electronic learning in Nigerian higher institutions, has been remedied through the development of this robust Android based system that can work both offline and online. When there is internet access, the online resources are downloaded from the database of the institution's learning platform into the local database on student's device so that when there is no internet access, learning could continue seamlessly through the resources on the local device of the student. As noted, also important for the successful creation and maximum utilization of the application is the theory of m-learning, as the understanding of its principles and elements is important for developing a beneficial education tool. The application will be of great use to the lecturers and students of Nigerian higher institutions. This will help the academic performance of the students in that the system is ubiquitous and robust such that it can be used online and offline.

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