Sign and Development of a Subject Progress Monitoring Android Application

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ABSTRACT

In Zambia, school performance is evaluated and analyzed through exams. Rarely does the government consider school performance according to other factors like teacher subject progress, facilities and co-curricular activities. This leads to look down upon the schools that do not perform well in national examinations. The research was conducted in 9 secondary schools out 11 of Luanshya District to establish the nature of the problem and to facilitate the provision of better understanding of the problem. The system consists of an android mobile phone for installation of subject progress monitoring android application, and a web- based system to allow supervisors, teachers and student/pupils to login and input necessary information, system administrator will enroll, deactivate and activate a user. The mobile application or SPMAA was developed to allow supervisors to verify the teaching objectives for various subjects and monitor learning activities. The waterfall methodology was used in developing the application and also a research survey design was employed prior to the collection of data and research tools such as questionnaires and field observation were implored. From the results obtained indicated the need for designing and developing a subject progress monitoring android application to address the shortcoming of the current evaluation system in secondary schools, the value of this research cannot be under estimated, as it sets the agenda for the future.

CHAPTER ONE: INTRODUCTION TO THE RESEACH

1.0 Introduction

The adoption and utilization of ICTs in Luanshya District of Zambia is a fairly new practice and not much is reported on this topic, thus it is essential to first have an understanding of ICT as a concept. According to Rouse (2005), ICT is a bigger term that encompasses any communication devices and applications that include television, cell phones, computers and other hardware and software networks, including satellite systems such as videoconferencing.

These ICT tools enable easy communication and sharing of information among individuals regardless of distance.

Education is a strong source for defeating poverty as it opens the doors of tremendous opportunities and gives an individual not only a chance to change his/her fate but also of many others of his community, country and ultimately the world as a whole in the current information technology (IT) era. In the modern world of mobile technology and their increasing availability and affordability, mobile devices particularly Android platforms play an important role in the field of communication,

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entertainment and learning. It has greatly changed the functioning of the world, even the learning process. Learning through mobile phones has become part of the educative system.

The drive of this study is to design and develop a Subject Progress Monitoring Android Application (SPMAA), by using android based mobile phone inside and outside the classroom. Android is a software stack that includes a Linux based Operating System, middleware and key application. It is designed to run on touch screen mobile devices like smart phones and tablet computers. Android Inc. was founded in Palo Alto of California, U.S. by Andy Rubin, Rich miner, Nick sears and Chris White in 2003. Later, Android Inc. was acquired by Google in 2005. It is now owned by Google in conjunction with Open Handset Alliance. This Alliance is a collection of 86 hardware, software and telecommunication companies developing open standards for mobile devices. Applications in Android are typically developed in Java programming language using the Android Software Development Kit (SDK). The java code is compiled into byte code (.class files) that is platform independent. The Dalvik interpreter converts the Java Virtual Machine compatible .class files into Dalvik Executable files (dex files) for runtime interpretation. The Android SDK provides the necessary Application Programming Interface (APIs) and developer tools for building, testing and debugging applications in Android.

One such developer tool is the Android Developer Tool (ADT) plugin for Eclipse IDE. An Android application consists of one or more of the following components: (1) Activities, (2) Services, (3) Content Providers and (4) Broadcast Receivers. Each component has a specific role and contributes to the overall application behavior. All the components used in the application and the device features are declared in the Manifest file. The Android application is also composed of Resources that are separate from the source code. These resources like the images, audio files, etc. contribute to the visual presentation of the application.

1.1 Motivation and Significance of the Study

The motivation and significance of this research is to design and develop a Subject Progress Monitoring Android Application (SPMAA), mobile application software whose main goal is to track the subject teacher's progress in his or her attempt to complete the schemes of work. This information is vital as it will help the Subjects heads as well as administrators make informed decisions as he/she will know what the students have been taught. Currently, research done in Luanshya revealed that most institutions use manual systems that have little and no verification, making them subject to abuse. The mobile app ensures that the lesson objectives entered into the system have been covered as it requires verification by the learner to verify what the subject teacher had entered. One cannot down play the value that will be derived from school administrators and subject heads monitoring the status of teaching/learning activities through their phones whenever they are away from office for instance. This research is very important to the extent that it will enable School Administrators monitor their staff through the android mobile phone instead of relying on third party reports which may not even be accurate.

Additionally, there is limited research on ICTs and teaching/learning (education) improvement in Zambia; most of the available research regarding ICTs is based on development of either agriculture or business enterprises such as small business enterprises (SMEs). It is true that agriculture is the core business of both urban and rural areas of Zambia, but ICTs should not only be limited to one sector. In order to expose the benefits that secondary schools can reap and ways in which ICTs

can be effectively used, the value of this research cannot be under estimated, as it sets the agenda for the future.

Therefore, it is the intention of this research to broaden the possible use and benefits of ICTs in fostering proficiency in the education sector particularly in secondary schools though designing and developing the Subject Progress Monitoring Android Application (SPMAA).

1.2 Scope

This research is limited to Luanshya District in the Copperbelt Province. The Subject Progress Monitoring Android Application (SPMAA) software is an android based mobile application which is designed to help institutions monitor the progress of a particular subject in a secondary school as covered by the Subject teacher.

The subject teacher will be required to record his/her lessons by entering the Lesson Title and Lesson objectives into the Mobile application. Whilst, a selected student (pupil) will be required to verify whether or not the lesson and the objectives were taught in a particular period. This information will be checked by the subject supervisor (head Of Department) or the Deputy Head, depending on the policy of the Secondary School.

In the development of this app, the researcher used the basic language of Android - Java, as well as XML for establishing the UI properly. The Mobile application uses the Native SQLite Database on the mobile as its database system. This app is built on Android Studio because this IDE enables one to use all the mentioned tools and on the other hand, it provides easy access as well as testing environment as it is easy to install an android Emulator or device to the IDE.

1.3 Problem Statement

Due to negative attitudes of some teachers toward work (Summers, 1990), there is need to design and develop a Subject Progress Monitoring Android Application (SPMAA) that will help head/deputy heads, senior teachers and HODs to verify and monitor whether teachers are fulfilling their teaching objectives. The app will help subject heads or supervisors to know if teachers are following the lesson plan and scheme of work, know whether topics are being taught in a logical sense by teachers, and know how far teachers have gone in their work and the speed at which the teachers are moving. SPMAA will also reflect activities or objectives that were successful or unsuccessful in a lesson in order to curb the negative attitudes.

1.4 Aim

The aim of this study is to Design and Develop a Subject Progress Monitoring Application (SPMAA) in secondary schools of Luanshya District.

1.5 Objectives

1.5.1 Main Objective

- The main objective of this project is to design and develop a Subject Progress Monitoring Android Application (SPMAA).

1.5.2 Specific Objectives

- To investigate the difference that SPMAA makes to teaching and learning of various subjects.

- To explore effective ways in which instructors (supervisors), teachers and leaners can use and benefit from SPMAA integration to teaching both social and natural sciences.

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1.6 Research Questions

1. How effective is a Subject Progress Monitoring Android Application (SPMAA) in the verification of teaching various subjects?

2. What are the teachers and supervisor's perceptions on the integration of a SPMAA in their secondary schools in their teaching of both social and natural sciences?

1.7 Organization of the Thesis

This thesis has five chapters. Following this, chapter one introduces the background information about the research, motivation and significance of the research, scope, problem statement, aim, objectives and research questions of the study. Chapter 2 explores the relevant literature from Global related literature, African Studies and Zambian Studies. Chapter 3 will present the methodological aspects of this study while chapter 4 will explore the results from this enquiry. Finally, chapter 5 provides a summary of the major findings, discussion of these and a final conclusion.

1.8 Summary

This chapter started with an introduction to the chapter which gives an overview of the research. The chapter also looked at the problem statement to justify why the research must be undertaken. It went further to look at the aim of the thesis and even what benefits users will derive from this research after its completion. The chapter also looked at the objectives or focus of the research; here we saw how the researcher intends to conduct the research or investigation. The chapter further looked at the scope and research questions of the research, which is what the research intends to cover and what it intends answer.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section reviews studies and other related literature on the topic of study. The discussion of literature has been done under the following heading: Related studies.

Over the past few years, several organizations have taken the initiative to implement m-learning. Some of these apps are Mobile Learn™, OppiaMobile Learning, Google Classroom, etc. Mobile Learn™ by Blackboard Inc. makes it easier for students to keep up with their courses by letting them access the materials whenever and wherever they want. But it can only be used for free if the institution of the student licenses it, otherwise it has to be purchased at $1.99.

OppiaMobile is also a similar mobile learning application developed by Digital Campus, which offers to run content exported from Moodle even when the student is offline. But these apps cannot guarantee that the content created by instructors or other users will always be compatible. For Blackboard's app, if there is no access from institution, features and functionality may at times be limited if the institution has not updated the appropriate software or experiences a server outage other similar apps include GoFormative (https://goformative.com/); Quizalize (https://www.quizalize.com)etc.

The above apps have received good reviews initially but recently their users have been experiencing problems like, not getting notifications properly, inconvenient user experiences, no option to remove profile picture etc. Users of OppiaMobile have also expressed dissatisfaction for several problems like: app not running at all, failure to upload materials by faculties etc. So, they all offer similar features like SPMAA but have limitations like:

- Inability to run on all mobile phones
- Failure to upload materials
- Frequent freezes and crashes

2.2 Related Works

In Bangladesh, Android, Apple and Windows Phone are the main Operating System for mobile phones. But android is the main OS in our country. More than 50% mobile users use Android. Fig 1.0 shows the pie chart of the Android users in Dhaka city. So, this platform is the best way to reach the users. Besides, these platforms devices are so available and start from very cheap budget. As user experiences, android is very user friendly.
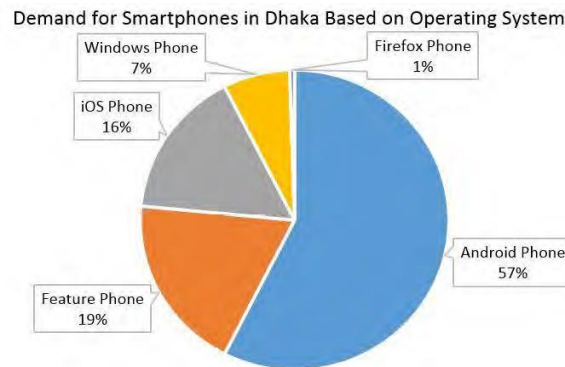

Figure 1.0: Usage of cell phones based on Android OS in Dhaka City

Source: Hawkins, 2004.
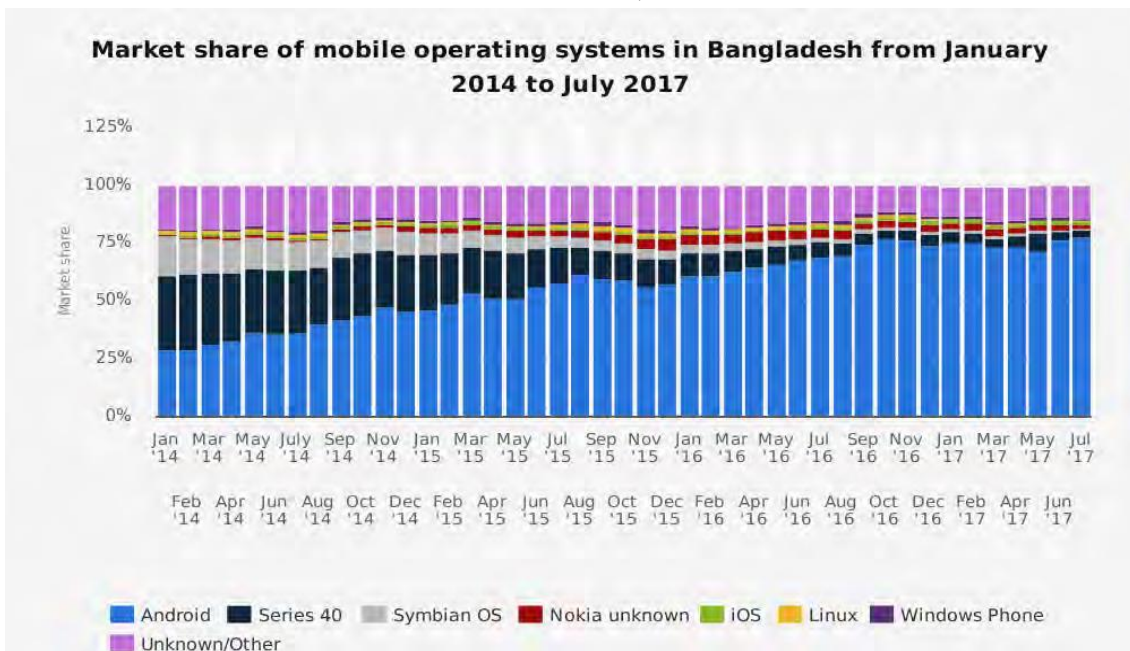
Fig 1.1: Android phone users in Bangladesh from January '14 to June '1
Source: Ayas, 2018.

According to Fig 1.1, in Bangladesh, most of the mobile users use the Android and the statistic shows us that the number of android users is increasing.

The android UI, UX is really attractive and easy to use. Android attracts innovation from both hardware and software developers. In android you

can run any app you want. It's easily upgradable. Even we can buy this with a very cheap price which is start from K400 and it's really very available even we can buy this from the nearest Phone shop. So, in every aspect android is better than any other platform in Bangladesh and that's why the researcher choose this platform.

The general domain regarding ICTs in schools has gathered significant research momentum in the recent years (Selwood & Pilkington, 2005). Studies about the integration of ICTs in the classrooms have been conducted in many parts of the world.

Hawkins (2004) observes that in the 21st century, the new vision of education is to make learning accessible to all, but it is hard to achieve this goal through the use of traditional methods. Hence, there is increasing demand for technology innovations in teaching and learning approaches. That is why pedagogies of school reform are now highly influenced by and built around constructivist theories of learning that assume the use of technology in education.

In another study conducted by Cano and Garcia (2013) the aim was to evaluate and analyse strategies, proposals and ICT tools to promote a paradigm shift in education supervision that enhances the schools in Spain, that were involved not only in teaching face learning but e-learning and blended learning. While the foregoing study was focusing on developing a new model that would complement the traditional models in education supervision, this study differs from the foregoing in that while the both are looking at ICTs in the education system, the current study focuses on the teachers' attitudes towards the integration of ICTs in the teaching and learning processes. However, both studies were promoting a paradigm shift from the traditional forms of pedagogy to the modern forms (ICTs).

In his study, Ayas (2018) notes that it is almost impossible to ignore the pervasiveness of information technology within education and that technology has become a valuable resource to educators. Similarly, Almekhlafi and Almeqdadi (2010) asset that technology integration in the classroom has become an important aspect of successful teaching because it allows students to learn more in less time and allows schools to focus on global learning environments if used appropriately. Consequently, many researchers have tried to investigate such integration (Zhao, 2007; Almekhlafi and Almeqdadi, 2010; Ayas, 2006; Isaacs, 2007 and Monteith, 2004).

According to Lam and Lawrence (2006), technology not only gives learners the opportunity to control their own learning process, but also provides them with ready access to a vast amount of information over which the teacher has no control. During the 20th century, education embraced technology believing that, education technology could facilitate unique learning environments or contribute unique features to make traditional learning more powerful and effective. Technology promised smarter, better educated and more fulfilled learners (Jonassen, 2000).

The significance of the works by Lam and Lawrence (2006) and Jonassen (2000) is that they touch on aspects that the researcher will explore. This study will further attempt to determine whether teachers appreciate that ICTs enable both teachers and pupils have access to a vast amount of information. It is possible that research findings for this study may differ since the study is conducted from a Zambian context.

Unlike the United States that is technologically advanced and developed, Zambia is a developing country that may not have ICTs integration in the schools as a priority area needing for attention hence the need to conduct this study. Some studies

like Zhao (2007) showed that some teachers use technology for its efficiency, some embraced it for the enhancement of their instructional practice and student enhanced learning, still others use it for relaxation and consider the use of technology as a win-win situation for themselves and their students.

The foregoing study is essential because it will provide an opportunity for the current study to make comparisons between findings from other countries and those from Zambia. However, Zhao's (2007) study did not consider views from teachers in the rural areas which this study does. It is imperative for the current study to explore secondary school teachers' attitudes towards ICTs integration in the classroom from a rural dimension because most people have misconceptions about rural areas. The current study will also look at competencies that teachers have in ICTs, availability of ICTs in schools and the level of ICT integration within and between schools. In his study on the role of ICTs in education, Mikre (2011) concludes that regardless of all the limitations characterizing it, ICT benefits education systems by providing quality education in alignment with constructivism, which is a contemporary paradigm of learning.

In yet another study conducted by Labored (2002), the study investigated the availability of ICTs in school, skills competence of secondary school students and the influence of the application of ICT innovations in teaching and learning. The findings of this study showed that the ICT availability in the secondary schools was low and students had low competence in the application of ICTs in learning Social studies.

In his study called, 'Understanding the Importance, Impacts and Barriers of ICT on Teaching and Learning in East Africa Countries' (Tedla, 2012) explored internal and external factors that surround ICT issues, policies of ICT integration, and factors that facilitate or impede the use of ICTs, with the focus of improving the quality of the teaching-learning process.

The study revealed that the inhibiting factors are unrealistic policies of ICT, poor infrastructure, lack of teacher competence, confidence, incentive, perception and beliefs, imposed curriculum, lack of proper network, political instability, brain drain, sporadic electricity, poor transportation, lack of public awareness and participation, poor school leadership, technological illiteracy, and lack of pedagogical skills. The study further revealed that ICT integration was far behind in East African schools as a consequence of ICT deficiency, absence of pre-service and in-service teacher training and poor teachers' welfare and morale.

A study conducted by Khosla (2013) whose title was 'iSchool: Transformative learning in the Zambian classroom.' Studied iSchool a stand-alone company in Zambia founded in 2010 whose core business is the production and sale of e-learning products which are produced and distributed by the company and targeted at school children across all income levels.

The study was basically gauging the use of the iSchool products (Tablet and projectors) in School. The conclusion was that though daunting challenges remain, through its e-learning programme, iSchool has ambition and potential to change the way education is delivered in Zambia. Khosla's (2013) study was examining iSchool as a company, its business, prospects and the impact its products have in the education system in Zambia. This study is different from the foregoing study in that apart from investigating the available ICTs in iSchool's pilot schools, it also studied How ICT are used in the schools across the curriculum and also focused on the teachers' attitudes towards the integration of ICTs in the teaching.

Hennessy et al (2011) conducted a study called, 'An investigation of Appropriate New Technologies to

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support Interactive Teaching in Zambian Schools.' This study sought to determine what suitable ICTs were currently available or likely to be available in the near future, and what factors needed to be considered in making choices for primary education. Hennessy et al's (2011) study gives premise on which my study stands. The researcher's study capitalizes on the fact that Hennessy's (2011) study did not raise any attitude related issues with regard to the usage of new technologies by the teachers.

In a study called 'ICT in Education in Zambia' conducted in 2007, Isaacs (2007) concluded that penetration levels of ICTs in Zambia's education institutions remained low, with those schools that are equipped mostly utilizing second-hand and refurbished computers. The integration of ICTs in teaching and learning practice has been limited, although the introduction of Computer Studies as a school curriculum subject has begun to change this. The foregoing is an important study as it gives the current study an opportunity to find out what ICTs are available in the schools and the level of usage across the curriculum. The current study, therefore, examined in detail the ICTs available in the schools piloting the e-learning programme so as to determine whether Isaacs' (2007) conclusion stands in all cases.

Mtanga et al (2012) conducted a study on the use of ICTs in education in selected urban based high schools in Lusaka, while Chaamwe (2012) did a research on Information and Communication Technologies (ICTs) for Zambia's Distance Education. Both studies concluded that the major challenges include teachers' inexperience and unwillingness to adopt ICTs in their teaching activities and the state of ICTs infrastructure in Zambia which was scanty and expensive.

The studies by Mtanga et al (2012) and Chaamwe (2012) are generally in line with what the current

study will do. Thus they provide a back ground to this study. However, the current study does not only look at the use of ICTs in education but largely focuses on the attitudes of the end users who are the teachers, administrators and learners in the use of the new software technology known as the subject progress monitoring android application promoting teaching and learning activities.

2.3 Summary

This chapter looked into some existing similar technologies and went further to review various systems which are related to the researcher's area of investigation and compared these works with this research work. In reviewing, this section has discussed related literature on the topic and problem under study using the following heading: Related Works. What has come out clearly in the literature are; the main arguments, deductions, conclusions and recommendations by various scholars and researchers. The literature has further been linked to the researcher's work by way of highlighting similarities, differences, meanings, relationships and gaps that exist. By ratio very few mobile software applications have been designed to address teacher subject progress. Most of the applications are centred only on the student (pupil) learning abilities without monitoring the learners learning progress for example, GoFormative (https://goformative.com/); Quizalize (https://www.quizalize.com)etc.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter looks at the dual methodologies that were used to aid the research. Firstly, a survey and secondly, waterfall model in software development. The chapter goes further to justify why the waterfall model was chosen as the concept the researcher was adopting to develop the smartphone app this research seeks to implement. Also, the population and sample size, development of the application and system design for this research are discussed. The tools used for coding the data and finally for the analysis are also discussed here.

3.2 Baseline Study

The sample size used in this research was ninety respondents out of the randomly selected nine secondary schools namely; Mpatamato, Luanshya boys, Luanshya girls, Mikomfwa, Roan antelope, Nkulumashiba, Central, Don Attavio and Twashuka. The areas were randomly selected out of the 11 secondary schools of Luanshya District. Simple random sampling and probability sampling method was used where the randomization was achieved by lottery method (Sarantakos, 2004). The randomization was achieved by allocating a number to each school and using simple random sampling by the lottery method a sample was been picked. This was to ensure that each respondent had a chance of being picked. In trying to make meaning out of the raw data gathered from respondents through the questionnaire, the researcher analysed the said collected data.

The raw data collected from the survey was changed into a structure that will be suitable for analysis through the process of coding. Every response item on the questionnaire needs to be entered as a number code (except narrative text). To do this, numbers are assigned to respondents' responses prior to data entry. This process is called data coding. After this coding process, Microsoft Excel was used to analyse the data and draw appropriate diagrams that reveal interesting trends between collected data.

3.2.1 Data Collection

Two types of data were collected in this research; primary and secondary data. Primary data was collected using interviews, questionnaires and observations in the field. Secondary data was collected through reading publications and records based on the subject matter. Data collection also addressed the following: the gender, age, level of education of the teachers, ICT tools available in schools, level of ICT usage in the schools, teachers who had attended ICT/ IT training or course, kind of ICT/IT training or course attended by teachers and availability of ICT specialists in schools. During data collection respondents were informed of the purpose of the research, the procedures that was used to collect data and assured that there were no potential risks or costs involved and that anonymity and confidentiality was maintained in keeping the data collected confidential.

3.2.2 Research Approach

Research approach addressed the following: both qualitative and quantitative methods of approach due to its nature. Qualitative research objective is to get an enhanced understanding through trustful reporting, first-hand experience and citations of actual conversations. The quantitative research was used to see the number of people who would like to use the new system or thought it was a good idea. In order for the researcher to be able to implement the android app for the system, the waterfall model was adopted to help in developing the android app.

3.2.2.1 Waterfall Software Development Methodology

The Waterfall Software Development Life Cycle Model was the Model used as the methodology for the project. Waterfall is a cascade SDLC model, in which development process looks like the flow,

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moving step by step through the phases of analysis, projecting, realization, testing, implementation, and support, according to Victor Osetskyi, 2010.

He further explains that, the waterfall model is a static model and it approaches systems development in a linear and sequential manner completing one activity before the other. This model consists of five (5) distinct phases and for an activity to start in each phase, the activity or activities in the phase preceding it must finish completely before the next phase can be executed. This model is document intensive and produces at least a document in each of its phases.

Figure 2.0 Waterfall Software Development Life Cycle Model.
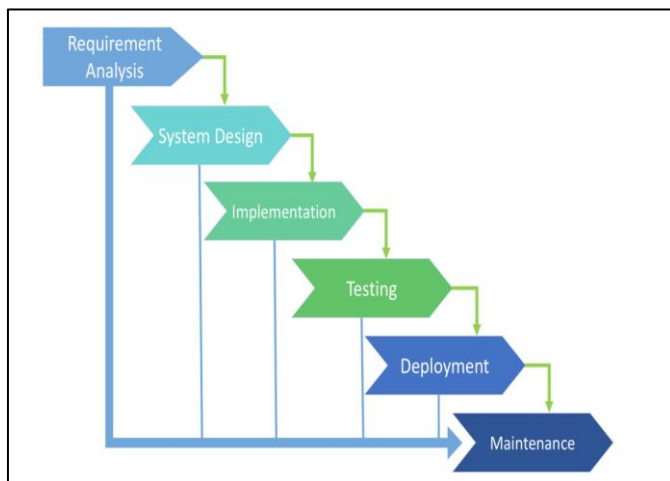
Source: Victor Osetskyi, 2010.

3.2.2.2 Phases of the Waterfall SDLC

The waterfall model consists of 5 sequential phases in a cascading order one after another, as shown in figure 2.0. These phases include the following:

a. **Requirement Gathering and analysis:** All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.

b. **System Design:** The requirement specifications from first phase are studied in this phase and the system design is prepared. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.

c. **Implementation:** With inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

d. **Integration and Testing:** All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.

e. **Deployment of System:** Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market.

f. **Maintenance:** There are some issues which come up in the client environment. To fix those issues, patches are released. Also, to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

3.2.2.3 Reason why the Waterfall Methodology

The researcher adopted the waterfall model as the preferred methodology in developing the android app because of its several advantages in using it to develop a system as follows:

- This model is instructive because it emphasizes the important stages of the project development and it is also very easy to understand and implement.

- As the model emphasizes planning at the early stages, it ensures design flaws are dealt with before they develop (Munassar & Govardhan, 2010).

- One other formidable reason why the waterfall model was adopted is because it reinforces good habits, that is define-before-design and design-before-code. It identifies deliverables and milestones during development.

- The model further produces several important documents such as User Requirement Document (URD) and Software Requirement Document (SRD) which are very important documents in any software development process.

- The Waterfall SDLC model Methodology was appropriate for this project in that the requirements for the Subject Progress Monitoring Application (SPMAA) were to be precisely be documented and product definition expected is stable.

- And the other reason is that the technologies stack is predefined which makes it not dynamic.

- And lastly, the development of the project is expected to be short.

Despite its several advantages, one major disadvantage of the waterfall model is that because the actual development of the system comes late in the process, one does not see results for a long time. This delay can be disconcerting to customers and management. However, once this is purely for research work and does not concern any customer or management, the above limitation or disadvantage of this model is of little or no concern here.

3.2.2.4 System Architecture

Mobile application architecture used in developing the SPMAA basically comprises the software that works on android operating system and the application saves its data in SQLite database located on the android operating system. A back-end web application was integrated with the android application to analyse user's requests. MySQL database was used in development of the application.

3.2.2.5 System Analysis

Object- Oriented Analysis (OOA) is the concept used in this research. OOA increases the understanding of problem domains because OOA promotes transition from the analysis phase to design phase and provides a more natural way of organising specifications. This study focused on use-case modelling, data flow diagram (context diagram), system class entity diagram, sequence diagrams, and database entity relationship diagram to explore the various approaches that are conducted in the analysis of the system. In the object-oriented system development life cycle, use case modelling is established in the analysis phase. Use-case modelling is done in early stages of system development to assist the developer gain project understanding of the functional requirement of the system, without worrying about how those requirements will be implemented.

3.2.2.6 System Design

Object-oriented design (OOD) technique was used to refine the object requirements definition identified during system analysis and to define design-specific objects. Design Class Diagram was used for general conceptual modeling of the systematics of the software, for detailed modelling to translate the models into programming code and for data modeling (Sparks, 2001). The research adopted Design Class Diagram to hold classes

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which contain the main objects, methods and interactions of the software. Entity Relationship Diagram (ERD) was also used, which is a graphic that illustrates the relationships between people, objects, places, concepts or events within a system, enabled the research to define work processes and to develop relationships between entities and their attributes in a relational database (Tech Target, 2000).

3.2.2.7 System Implementation

Java was used to develop android application. MySQL was the relational database management system that was used. MySQL was preferred because it is open source and cross platform. PHP was chosen because it is fast and platform independent (Sakshay, 2013).

3.2.2.8 Requirement Definition or Specification

The requirements definition is specifying the requirements of the system. The system to be developed consists of two components which are an android app and a local web-based system (website) which will be used locally by system administrator for remote system administration purposes, school administrators, teachers and a school monitor from each class. The system is supposed to monitor the teaching/learning activities and verify whether teaching objectives were either successful or not to school administrators (supervisor) through their android smartphones. The app when implemented is also supposed to allow system administrator login to database that will run an android application. The developed solution has the following actors: teacher user, student user, supervisor user and administrator user.

3.2.2.9 Non-functional Requirements

The system shall ensure that unauthorized users do not have access to it since access permissions can only be changed by the system administrator. In terms of, performance, the system will react very quickly to user inputs and will also be very accessible to users since it will be web-based (users only need to have access to internet to access it).

3.3 Development of the Application

The researcher used the following steps as below to develop the application in an effort to achieve the objectives for the dissertation:

i. Step 1: Feasibility Study
ii. Step 2: Data Collection
iii. Step 5: System Design
iv. Step 6: Software Development
v. Step 7: System Testing
vi. Step 8: Conclusions and Recommendations

Step 1: Feasibility study aims to show the need for research and see if it adds any value to existing systems and designs. An extensive research of other projects in different parts of the world was carried out to investigate technologies used in relation to the scope of this study.

Step 2: Data collection methods such as interviews, questionnaires as well as observation were used to gather information.

Step 3: Design of the system or application according to the data collected.

Step 4: Application development according to the data analysis. Establishment of communication channel between the hardware and software was implemented in this phase.

Step 5: System testing to ensure that the required functionalities are working as per the requirements.

Step 6: Discussion of the system in reference to the set objectives and requirements. Recommendation for future work is also highlighted during this stage.

3.4 System Design

The collection of the requirements from potential users were merged with ideas that the researcher had in mind to come up with an application design with desirable functionalities to fulfil its objectives. The following design diagrams and corresponding information were used to guide the actual implementation of the system:

3.4.1 Context Diagram

A context diagram is high level data flow diagram showing the movement of data in the system. It shows the entire system as a single entity interacting with external entities and the processes that take place between the system components. In the system, there are four main external entities whose interactions with the systems have been clearly shown in figure 3.0.
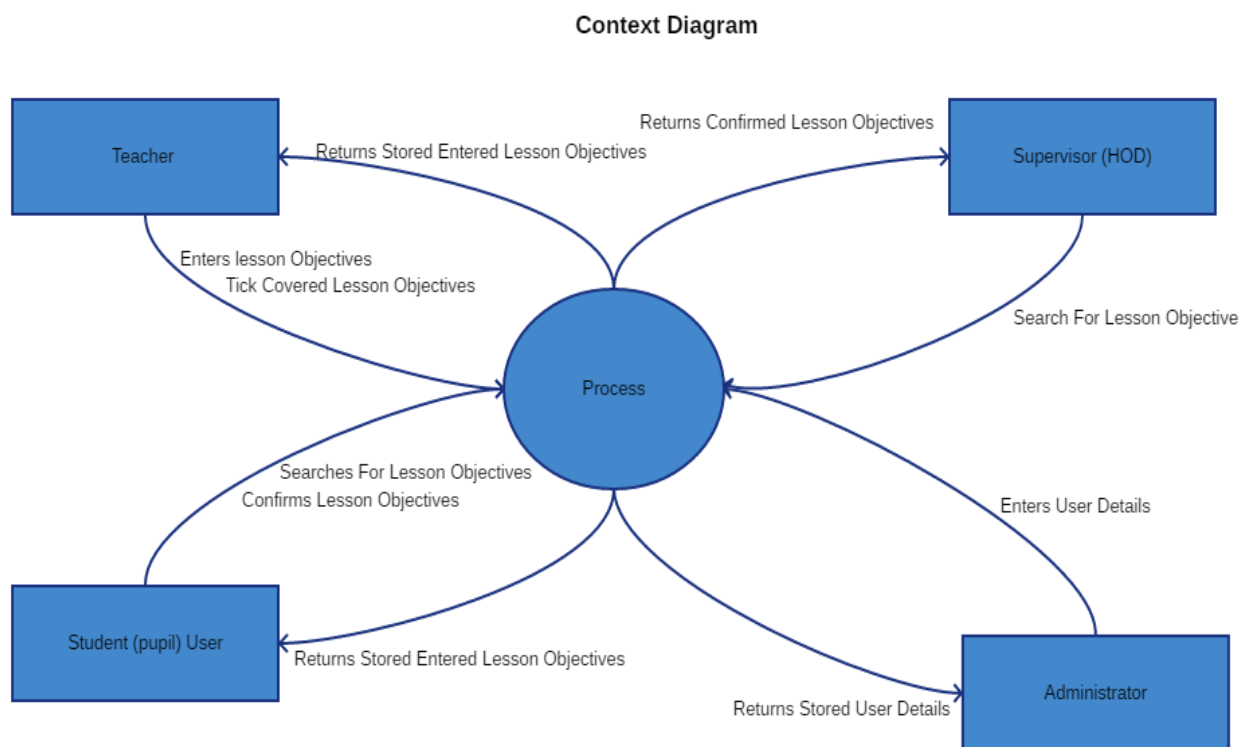
Figure 3.0: Context Diagram. Source: Author's Construct, 2019.

Subject Progress Monitoring Android Application (SPMAA) Mobile application software System basically has four entities including the teacher (instructor); The Student (Pupil); supervisor ((HOD); and the System Administrator (School IT Personal). These four entities will interact with system as the system users.

3.4.2 System Software Level Architectural Design

In this phase, the sub-systems and or components that must be put together to come up with the complete system and the interconnections between these sub-systems are identified. Also, how the system interacts with other systems and users is identified here. It is an android application software

that works on android operating system. The application saves its data in an SQLite database located on the android operating system. After storing the data on the phones database, the application will then further upload that data on a remote Database system a MySQL preferably the institutions website as illustrated in figure 3.1. This data will then be retrieved by a different individual through the SPMAA software on their phones.
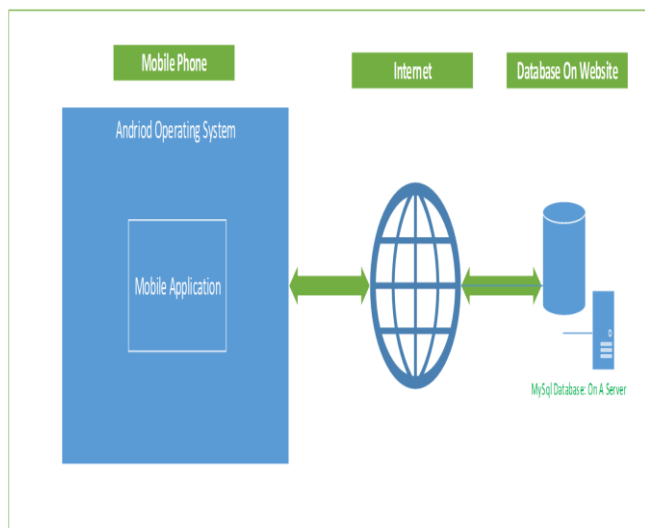

Figure 3.1: System Software Level Architectural Design.

Source: Author's Construct, 2019.

The application uploads data to school's website via the Internet and retrieves data via the same method as shown in figure 3.1.

3.4.2.1 System Requirements

These system requirements included the functional and non-functional requirements collected by the researcher come up with the system architecture to show how the system works, figure 3.1 shows how the architecture of the system is and its various components. It shows the modules in the application the mobile phone and web module.

Subject Progress Monitoring Android Application (SPMAA) Mobile application software is deployed on an android operating system a native application software and will work as a single unit. The mobile application will need to communicate with a native database (SQLite database System) within the mobile smart phone, which in turn will store the information as entered by the user. As illustrated in Figure 3.2
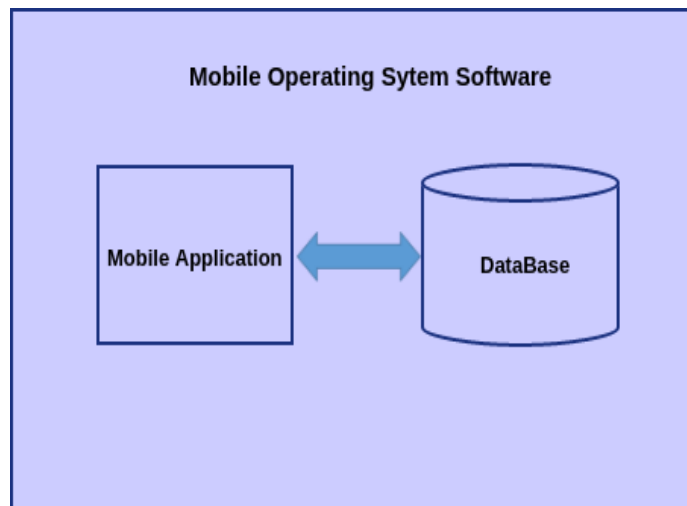
Figure 3.2 Block Diagram of the Subject Progress Monitoring Application Software.

Source: Author's Construct, 2019.

Each user will have to save data twice, firstly on their phones and secondly will have to save on website for the school as shown in figures 3.1 and 3.2.

3.4.2.2 Development Tools and Technologies

In developing this system, some tools and technologies were used to aid the researcher come up with a system that will meet its intended objectives. The languages, tools and servers that were used in developing the system are outlined in table 1 and 2.

Table 1: Languages

Language	Purpose
XML	For establishing the user interface
SQLite	Database on the mobile as its base system
Java	As basic language of android
MySQL	DBMS for designing and keeping track of users who logon to server using android phone
PHP	Scripting language for developing PHP application that will run on a server machine
JavaScript	Scripting language used to carry out spontaneous functions for the website.
Json	Scripting language used to communicate between the Android System's Java code and the website's PHP code. That is sending requests and receiving response through HTTP request system.
HTML	Mark-up language for Designing Structure of the website
CSS	Used for designing the appearance of the website.

Source: Author's Construct, 2019.

Table 2: Tools and Server

Tools and Server	Purpose
Android Studio	This app is built on android studio because this IDE provides easy access to a testing environment, as it is easy to install an android emulator or device to the IDE
Visual Studio	This IDE was used for scripting the PHP code, the JavaScript, CSS and the HTML languages.
Xampp	The server was used as a test server for the website to run the PHP and the MySQL code.
Evolus Pencil	Used for design and constructing illustrative and descriptive diagrams for the documentation.
Microsoft Office 2010	For writing documentation

Source: Author's Construct, 2019.

3.4.3 Modular Design of the System Function

Subject Progress Monitoring Android Application (SPMAA) is divided into small and independent **modules** which have some specific functionality. This decomposition into modules has a number of advantages such as:

- **Decreases complexity:** This will allow the designing and writing code for a small functionality (module) at a time instead of worrying about the whole big program.
- **Decreases duplication of code and allows re-usability:** Instead of repeating the same block of code when some specific functionality is needed, a module can be written and then called from different parts of the overall code as needed. This way, we can thoroughly test that functionality in one place and if any fixes or future changes are needed, they are done in that one module instead of multiple places in the code.
- **Improves collaboration:** It is easier to divide work among team members and teams where each developer works on separate modules.
- **Makes it easier to test:** Modules can be tested independently and in parallel by different testers such that overall testing can be more focused and done faster.

As SPMAA is written in Java programming and XML, the modules are divided Java classes and methods. These classes include:

- Main Activity Class which allows the user to login into the App.
- MainMenu Class which displays all available functions for a specific user
- Database Handler which handles all databases queries and responses.
- Enter-lesson Class which handles lesson registration and retrieval.

3.4.4 System Class Diagram

The interaction of all the classes in the system and corresponding attributes and methods they need to implement, which are depicted in the figure 3.3 below:
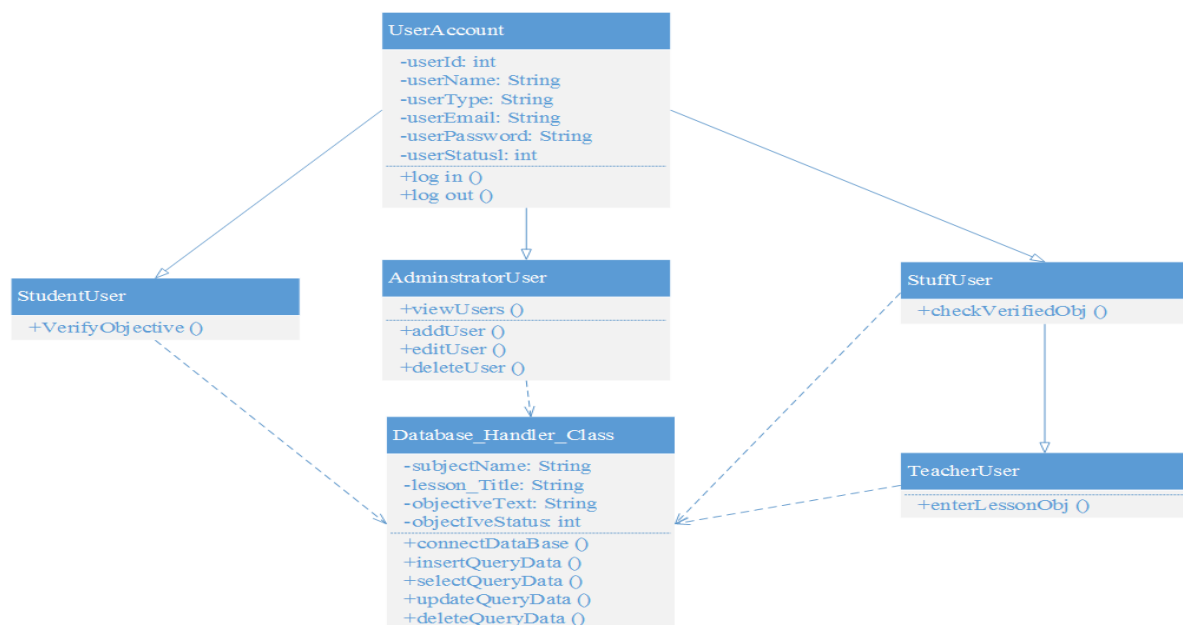

Figure 3.3: Class Entity Relationship Diagram. *Source: Author's Construct, 2019.*

Student Account will inherit and implement all attributes from the Main account but it will also implement its attribute own. The verify Method will mark each lesson objective which the student user has identified as an objective covered in the class. Stuff Account also will inherit and implement all attributes from the Main account but it will also implement its own attribute. The check Object method (attribute) is sends a search query in which for a specific lesson objective. It is this method that uses obtains lessons objectives and shows the confirmed learned objectives and the other methods. Teacher User Account inherits methods from the Main Account and from the Stuff Account. It is grand-child class for the main account so to say. Therefore, all methods from the both main account and the stuff Account can be used in the teacher account. On the other hand, the teacher account has its own methods, such as the enter Lesson Method. This is the method that used in the creation lesson objectives.

3.4.5 Database Entity Relationship Diagram

In order for the system to be able to keep track of system administrator who logon to the system and also keep track of the users created by administrator through their android phones, a database is required. The system also needs a database to keep track of servers added onto the system by system administrator, and again a database is needed to accomplish this. The diagram shown in figure 3.4 below represents the Entity Relational (ER) diagram.
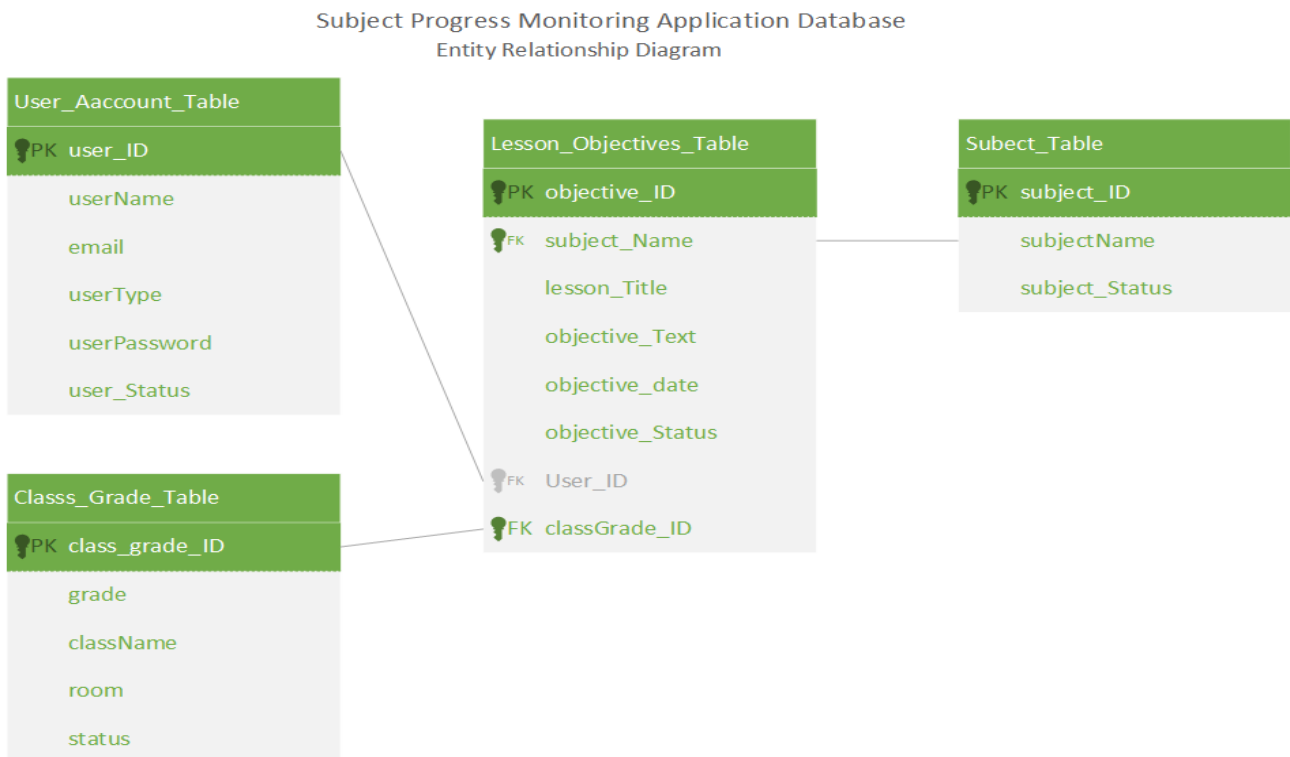
Figure: 3.4. Database Entity Relationship Diagram.

Source: Author's Construct, 2019.

The Subject Progress Monitoring Android Application Software (SPMAA) records its data in a single database which consists of four tables, namely, Subjects Table, User Accounts Table, Grade Class Table and the lesson Objectives Table. See Figure 3.4.

i.   Subjects Table - stores data "subject's records".

ii. The User Accounts Table - store user records. These user accounts are divided into four Types of accounts, namely:

   a)   Administrator Account which is used by the Administrator who might the IT person.

   b)   Supervisor Account which is used by the Head of department.

   c)   Teacher Account which is used by the subject tutor.

   d)   Student Account which is used by the student (pupil).

iii. Class Grade Table - Stores grade Class records. Each grade can have multiple classes. For example, grade 9 A, Grade B, Grade 9 C and so on.

iv. The lesson Objectives table stores the Lesson Objectives as entered by the Teacher User. These Records act as instances for each learning day. Meaning whenever a teacher enters the lesson objectives a single record is stored in the Lesson Objectives table. It is this record the systems update when the Student user verifies the lesson Objectives and reads when the Supervisor seeks to see the verified lesson Objectives.

3.4.5. 1 Relationship

And finally, the Lesson Objectives Table that stores data about the lesson objectives. The lesson table three foreign keys from the subjects Tables; User account table; and class grade Table.

   i.   The Lesson Objectives table uses the User Account's user ID field as a foreign key to identify which user created the lesson objective.

   ii.   The Lesson Objectives table uses the class grade's class grade primary key field as a foreign key to identify in which class the lesson objective was covered.

   iii. The Lesson Objectives table uses the subject's subject_ID primary key field as a foreign key to identify which subject the lesson objective belongs to.

3.4.6 Subject Progress Monitoring Android Application Remote Database

As explained earlier, the Subject Progress Monitoring Android Application (SPMAA) also uses a secondary database resident on the institution website. Figure 3.5.
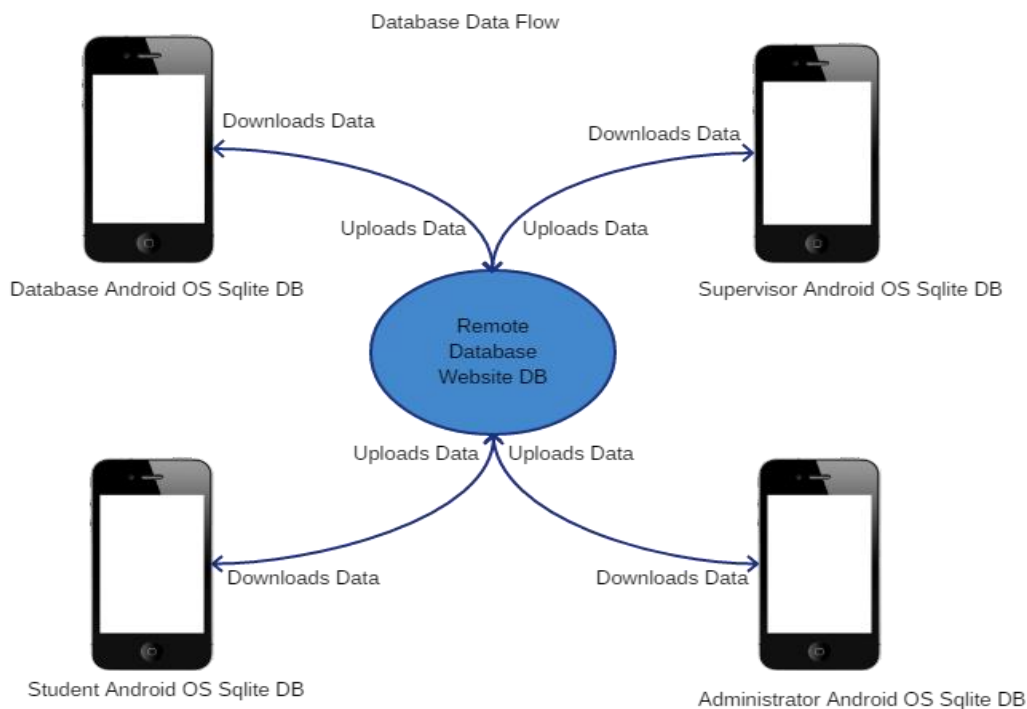
Figure 3.5: Remote Database Website.

Source: Author's Construct, 2019.

Each database uploads its data on to the remote database on the institutions website or just a rented database. For the application retrieve it seeks the data from the uploaded data on remote database. Therefore, remote database acts as the main storage for the entire system and the native database for native database.

3.4.7 Use Case Diagrams

The use case model uses actors and use cases. Use case concepts are simply an aid to defining what exists outside the system which are referred to as actors and what should be performed by the system referred to as cases (Wegmann and Genilloud, 2000). This app makes use of two use cases i.e. student and stuff use case. The diagrams shown in figures 3.6 and 3.7 below shows the application's functions as defined using the following Use Case Diagrams.
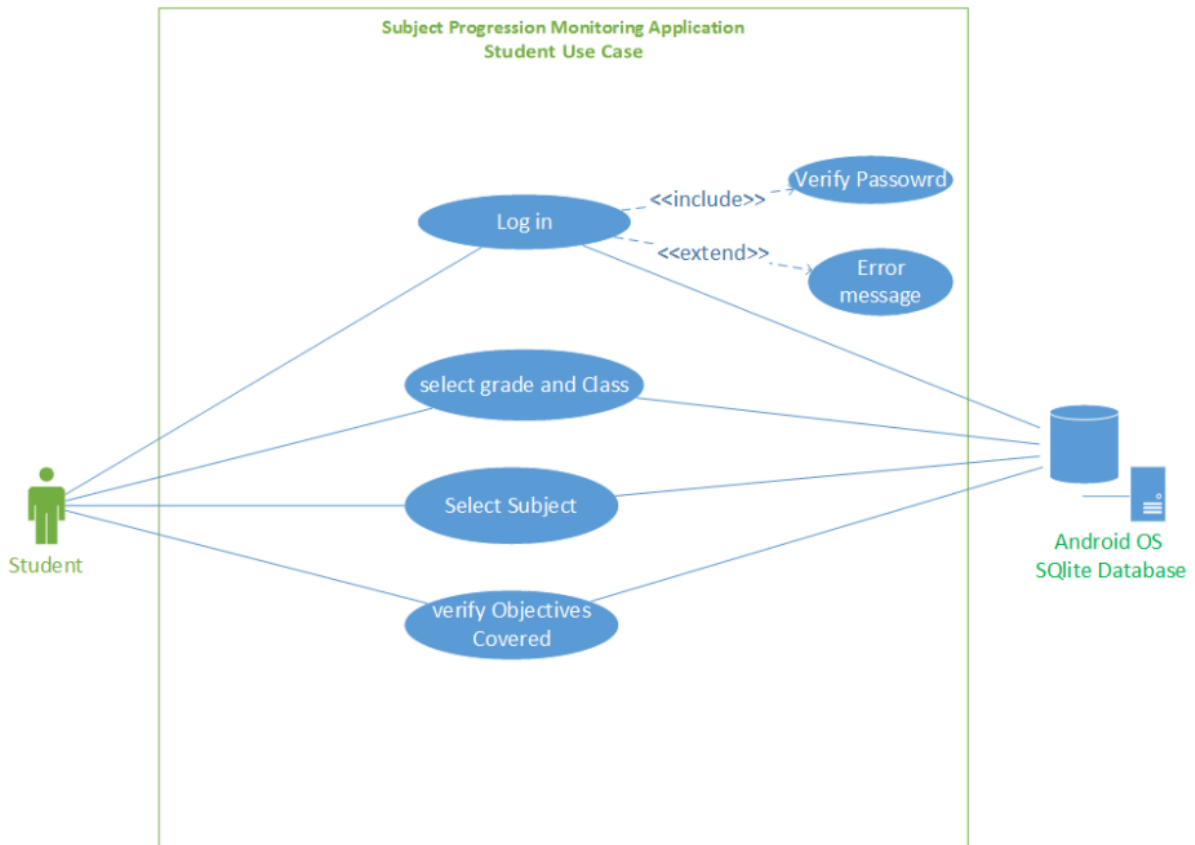
Figure 3.6: Student Use Case Diagram.
Source: Author's Construct, 2019.

3.4.7.1 Student

The Student is a pupil at particular who attends (takes) a particular subject, for instance, Biology. This Student will interact with the SPMAA in the following ways. Firstly, the student users will be able to search for particular lessons in particular subject. Secondly, upon finding the intended lesson, the student will verify the lesson objectives. The verification will only be done by the user when she/he ticks on a box to approve or disapprove the lesson objective. As shown in figure 3.6.

The System should be able to respond to the search query has posted by the student by showing the objectives entered by the teacher for the particular lesson which was searched for. This allows the student to verify a particular objective by ticking on the objective covered.
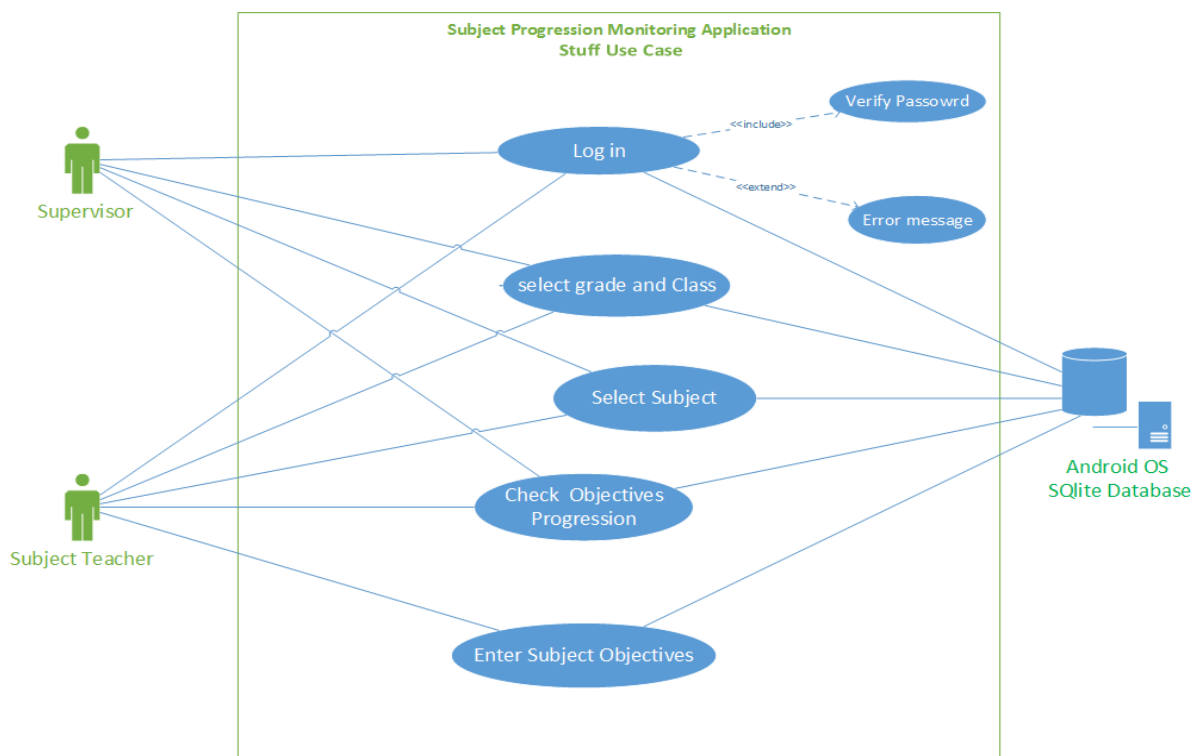
Figure 3.7: Stuff Use Case Diagram.
Source: Author's Construct, 2019.

3.4.7.2 Teacher (Subject Instructor/Tutor)

The Teacher is the instructor for a Subject. He/she Teacher users will be able to enter lessons and objectives to be covered, as shown in figure 3.7. The application will allow at least three objectives as per recommended by the ministry of Education in Zambia.

3.4.7.3 Supervisor User

The Supervisor is the personal individual with the responsibility to monitor particular subjects. This individual could be a school's Deputy Head Teacher, senior Teacher; or even a subjects Head of Department (HOD). The Supervisor user will be able to enter subjects and search for lessons. The user will view the objectives which have been approved and disapproved by the student user.

3.4.7.4 Administrator User

The Administrator is the school's IT person. This role is option has it can be given to anyone with basic computer skills. The administrator user will add and remove user from the mobile application system. He will also be able to grant user privileges.

3.4.8 Sequence Diagrams

A sequence diagram shows interactions between actors and the system and also between system components (Sommerville, 2009). The diagrams in figures 3.8 and 3.9 puts on show, the sequential flow of information passing through the main entities in the system. This is shown through the messages passed back and forth the respective components.

Subject Progress Monitoring Application
Enter Lesson Objective Scenario
Sequence Diagram
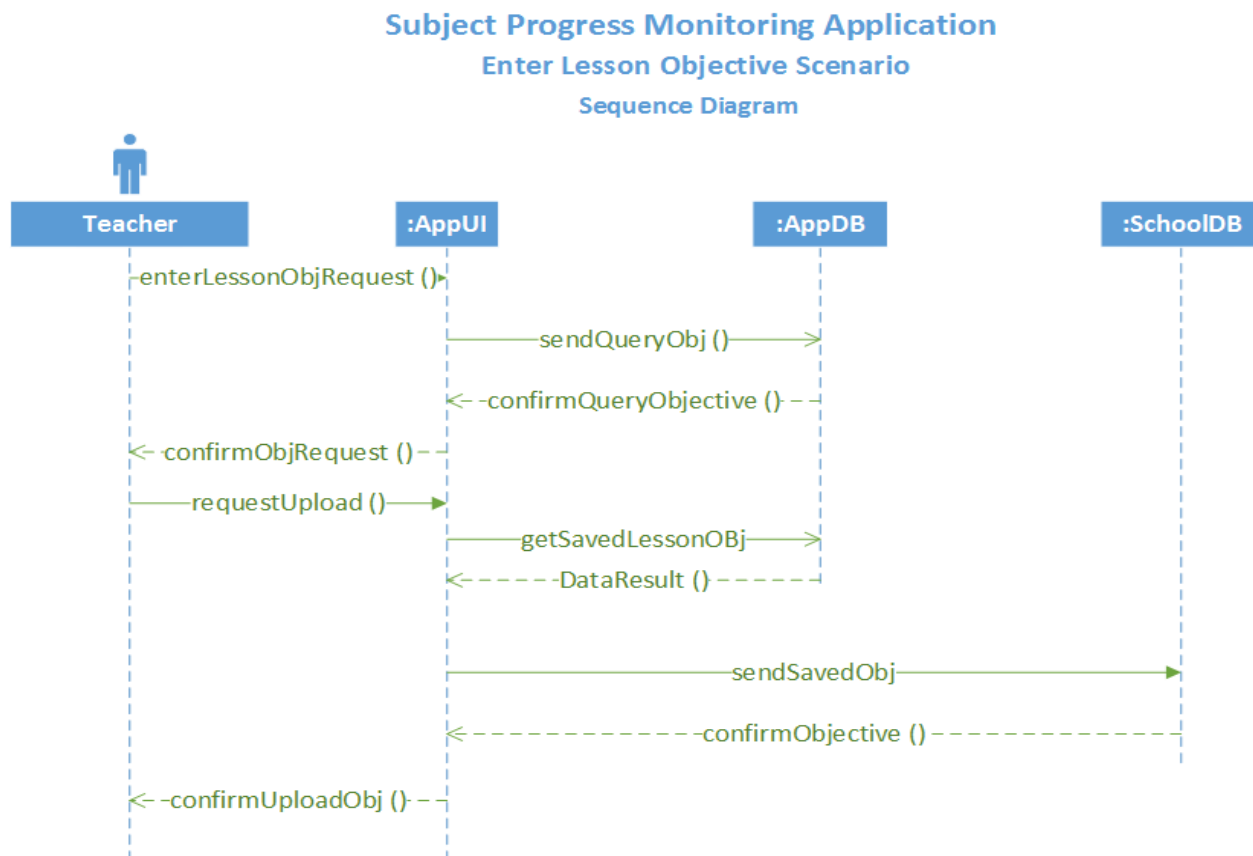
Figure 3.8: Teacher Sequence diagram of system.

Source: Author's Construct 2019.

The scenario in Figure 3.8, depicts the series of events which will occur when the teacher user enters a lesson's Objectives. The sequence in this scenario will occur every time a lesson objective is entered.
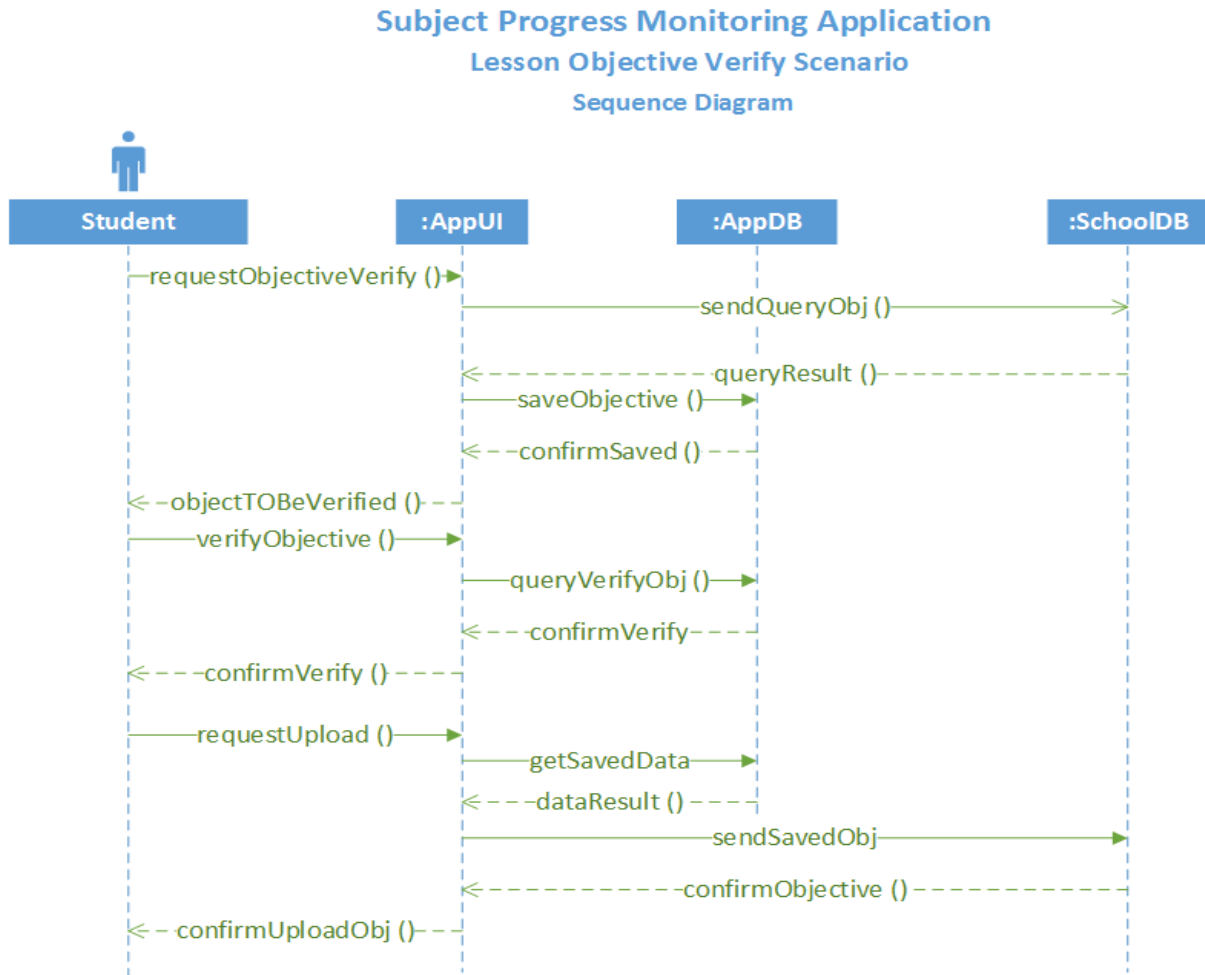
Figure 3.9: Student Sequence diagram of system.
Source: Author's Construct 2019.

Figure 3.9 illustrates the sequence of events which is expected to happen when the student user initiates a lesson objective for verification. Take note, this scenario will happen every time an objective is verified.

3.4.9 User Interface Design

The User Experience Design (UXD) on the Subject Progress Monitoring Mobile Application is simple to understand and easy to operate. This is significant because it will at times require computer illiterate individuals to operate it. The Application is designed to operate solely on a mobile phone. A first-time use the Mobile application will request for the user to login as an administrator user as Seen in figure 4.0.
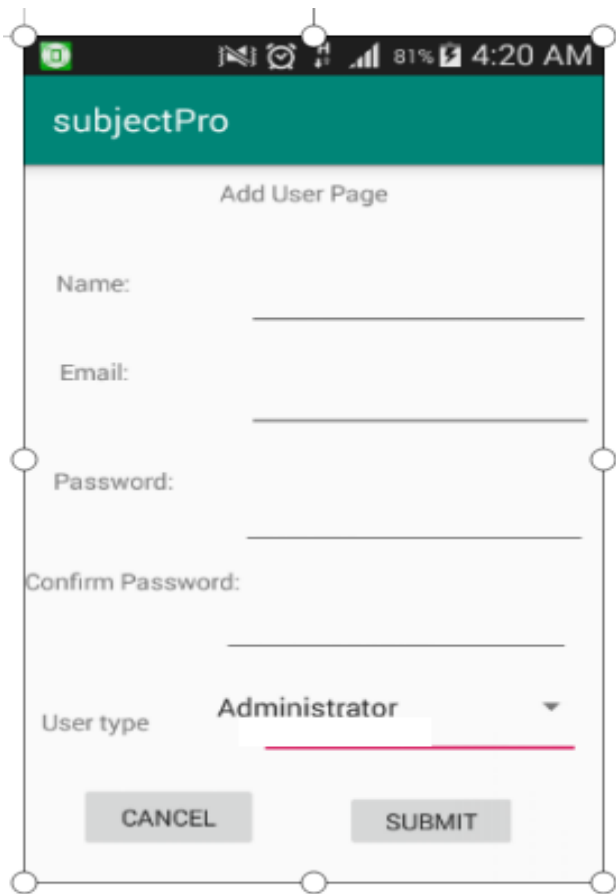
Figure 4.0: UI Workflow: Administrator: Add Users.

Source: Author's Construct 2019

Upon registration a successful registration the application will then present the user with the Log-in page as seen in figure 4.1. The new user will then log-in as administrator user.

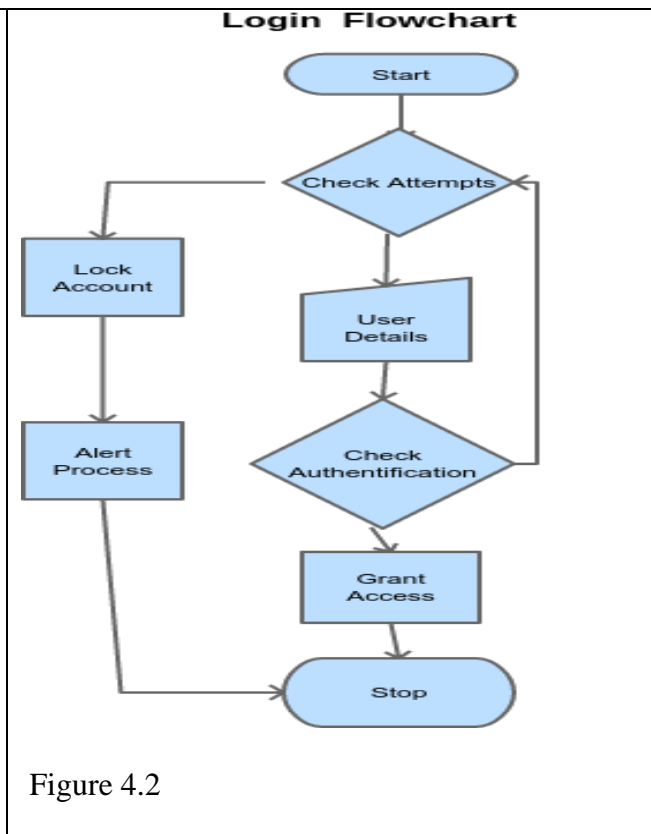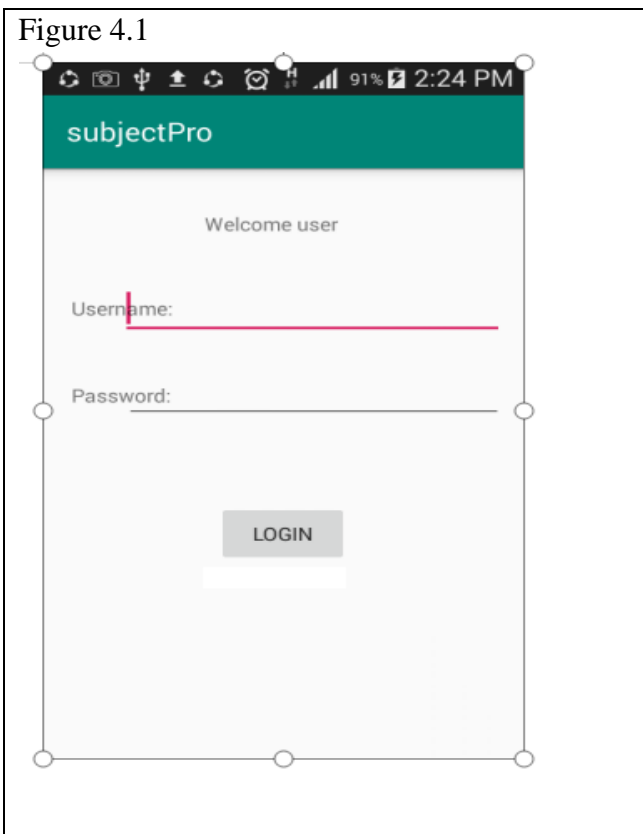**Login-In Page**. *Source: Author's Construct 2019.*

Figure 4.1

Figure 4.2

The administrator will add other users and they will have log-in as the administrator in Figure 4.1. The log-in will have a given number of attempt a user will attempt when login-in into the Mobile Application as in the Flowchart Diagram in figure 4.2.

After a successful login a user will be presented with a list activity one would undertake as seen in Figure 4.3. However, take note that the list of activity options will be limited to the user type (student, Teacher, supervisor, Administrator) of the user logged in with.
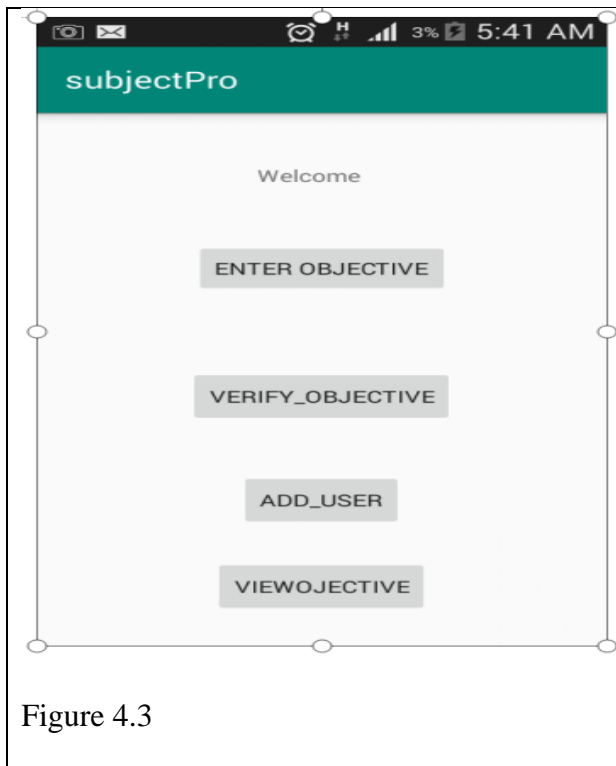
Figure 4.3

Take Note:

Teacher Users: will only be able to view "Enter Objectives" and "View Objectives"

Student Users: will only be able to view "Verify Objective"

Supervisor Users: will only be able to view "View Objectives"

Administrator Users: will view every available option
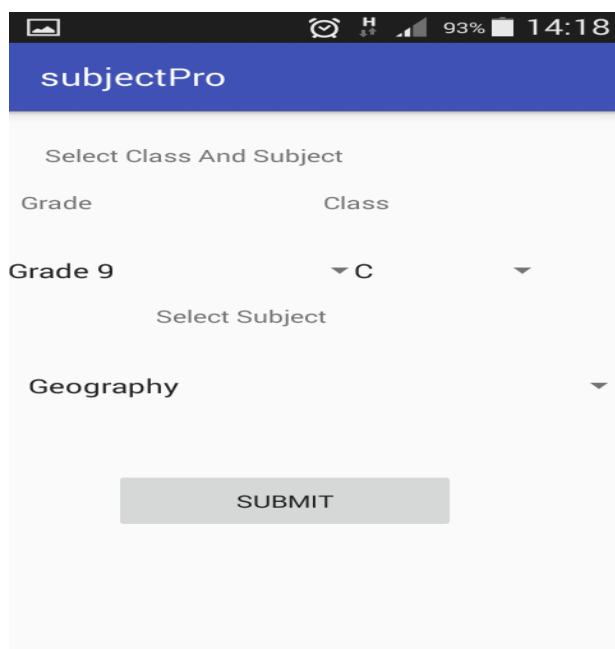
Source: Author's Construct 2019

Figure 4.4: Users Selects Subject and Class.

Source: Author's Construct 2019.

Upon choosing an activity The User will then have to pick a particular class by choosing the grade class and a subject as show in Figure 4.4. The Teacher user will enter "The Date"; "Lesson Title" and three objectives on the create lesson page which upon pressing the objectives page, as seen in figure 4.3. The Student User will search for a particular lesson by entering the date of the lesson and will verify (approve) a lesson Objective by Ticking in the checkbox.

He/she will submit his/her action by pressing the submit button, as seen in figure 4.5. The Supervisor (HOD) user will use search for lessons by entering the date and pressing go. The mobile application will then list the three objectives according to as per verified. See figure 4.6.
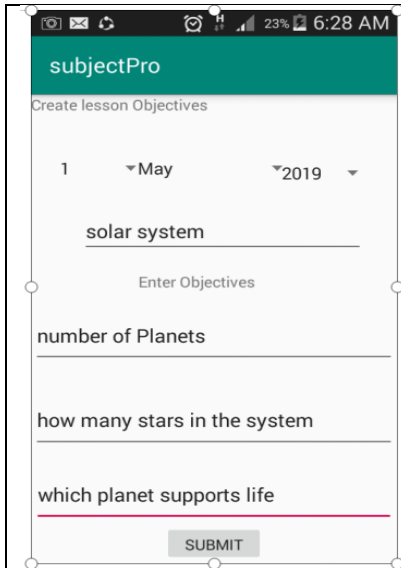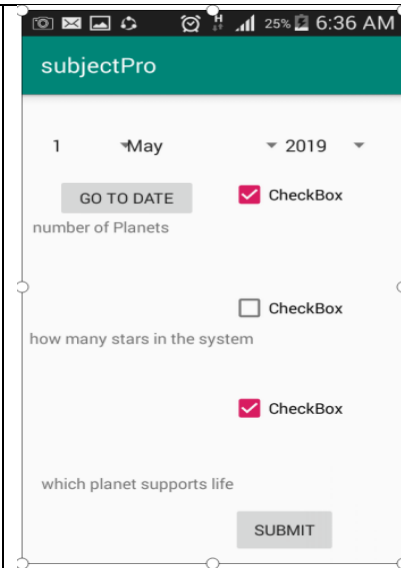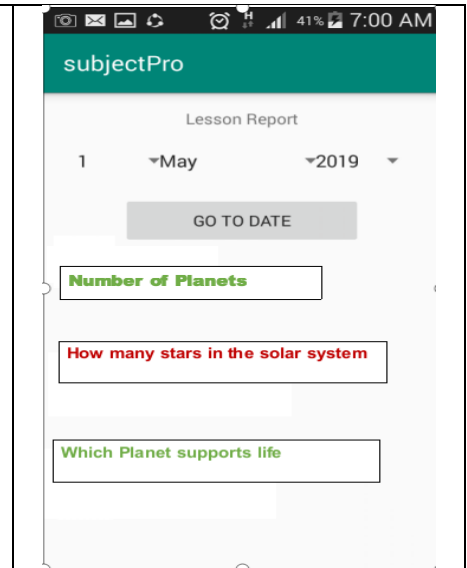
Figure 4.3.

Figure 4.5.

Figure 4.6

Source: Author's Construct 2019.

3.4.9.1 Hardware interfaces
Since neither the mobile application does not have any designated hardware, therefore it does not have any direct hardware interfaces.

3.4.9.2 Constraint
The mobile application is constrained by the capacity of the database on a particular mobile phone device. The application by default solely uses the mobile phone database to store all records. Careless storage of Passwords by the user could lead unauthorized user to login and interfere with the data on the phone. Therefore, user will be required to be prudent in their handling of the login passwords.

3.4.9.3 Assumptions and Dependencies
One assumption about the product is that it will always be used on mobile phones that have enough performance. If the phone does not have enough hardware resources available for the application, for example the users might have allocated them with other applications, there may be scenarios where the application does not work as intended or even at all.

3.5 Summary
The chapter looked at the software requirements and also went further to look at the database relationship diagram and class entity relationship diagram. The context diagram and modular design of the system function of the android app were also presented in this chapter. Use case diagrams and sequence diagrams were also discussed in this chapter. The tools and technologies that were used to develop the system were also discussed here. Snapshots of the system's interface were also included here. The hardware interface, constraints, assumptions and dependencies of the system were also looked at here.

CHAPTER FOUR: RESULTS

4.1 Introduction

Collected data was coded in order to convert it to numerical data that can facilitate statistical analysis using Microsoft excel. Coding is the process of converting verbal responses to numerical codes. It was done after data collection. Each response was given a numerical code to enable data to be standardized and processed well. The numbers expressing the codes are called values and the concepts they represent are value labels. It's their values and value labels that are entered in the computer and analyzed using selected software. Sarantakos, (2004).

4.2 Baseline Study Results

In this section, we look at the results of the survey which was conducted as part of this research, on which the motivation for development of the app was based. In the next section, we look at the results of the implementation of the system.

4.2.1 Survey Results and Discussion

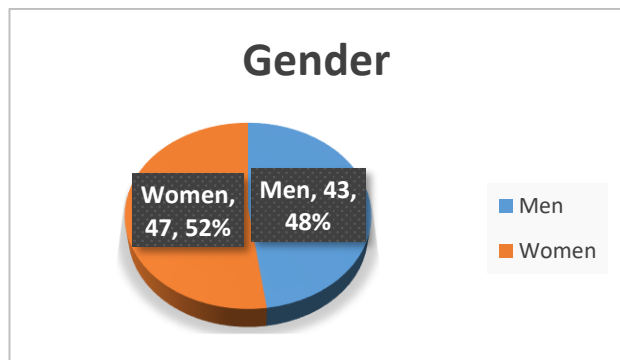### 4.2.1.1 Analyzing the Teacher Response by Gender

Figure 5.0: Gender

A total of 90 teachers were randomly selected from the nine secondary schools; Out of 90 respondents, 47 were female while 43 were male. The gender of the respondents was 52% female and 48% male.

4.2.1.2 Age Distribution of the Teachers

The teachers were asked to indicate their age. The distribution of the teachers by age was tabulated in the column chart.
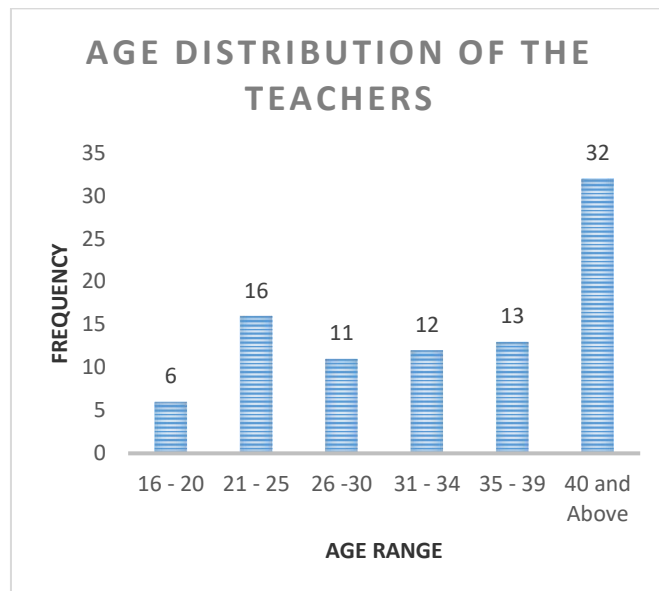

Figure 5.1: Age Distribution

From the results obtained, it is clearly seen that the age group mostly involved in teaching activities ranges from 40 years and above which constituted 32 teachers. The group with the lowest participation in teaching activities is that of the young, ranging from 16 – 20 years which constituted 6 teachers.

4.2.1.3 Level of Education Attained by the Teachers

To find out the level of education attained by the teachers, they were asked to indicate the same. Bar chart represents the data.
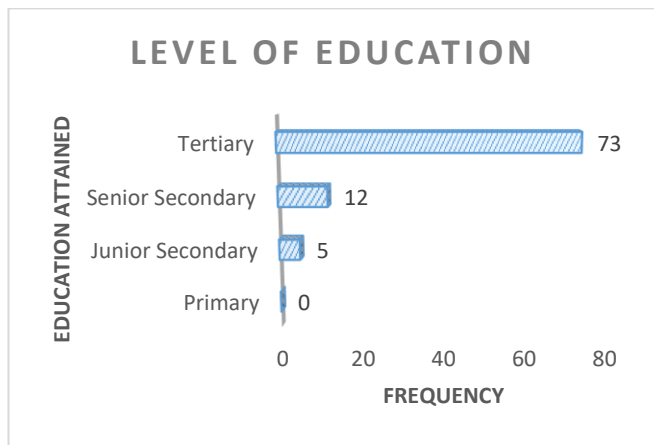
Figure 5.2: Level of Education

Data on education reviewed that zero (or 0) of the respondents had formal primary level of education, 5 had formal junior secondary education, 12 of the respondents had formal senior secondary education, while a large number of the respondents, 73 had tertiary education.

4.2.1.4 ICT Tools Available in Schools

The teachers were asked to indicate the availability or unavailability of various information communication technologies. The results were analyzed as follows in the pie chart.
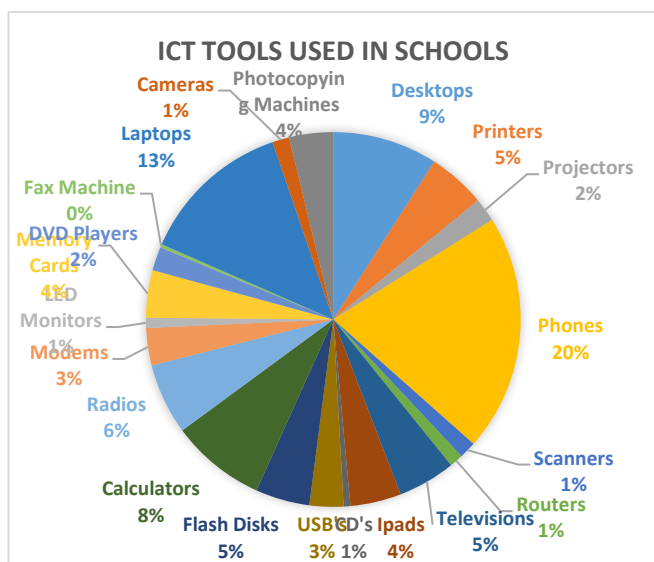

Figure 5.3: Available ICT Tools

Teachers in Luanshya secondary schools make use of various ICT gadgets, they use different ICT tools such as phones, laptops, desk tops, printers etc. Phones are the most common which is revered by 20% of the respondents followed by laptops revered by 13%. Desk tops followed at 9%, calculators at 8%, radio at 6%, TVs/printers/flash disks at 5%, photocopying machines/iPad/memory cards at 4%, modems/usb cables at 3%, DVD players/projectors at 2%, while 1% for routers/CDs/scanners/LED Monitors/cameras and 0% for fax machines.

4.2.1.5 Level of ICT/IT usage in teaching and learning
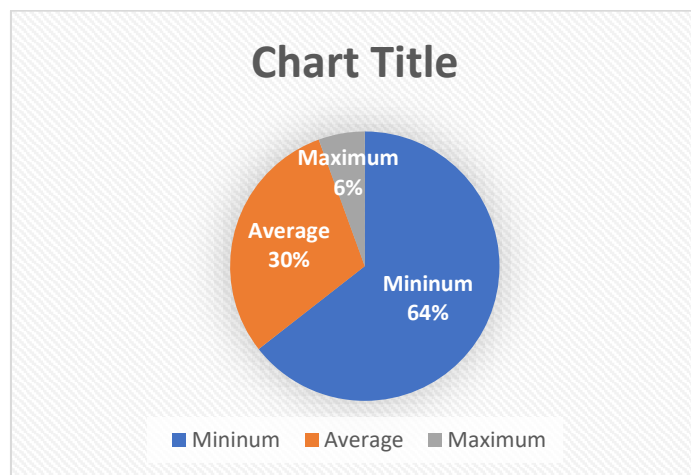

Figure 5.4: Level of Usage

4.2.1.6 Teachers who had attended IT/ICT Training or Course

Teachers were asked to indicate if they had attended IT/ICT course/training. Their responses are shown in the pie chart.
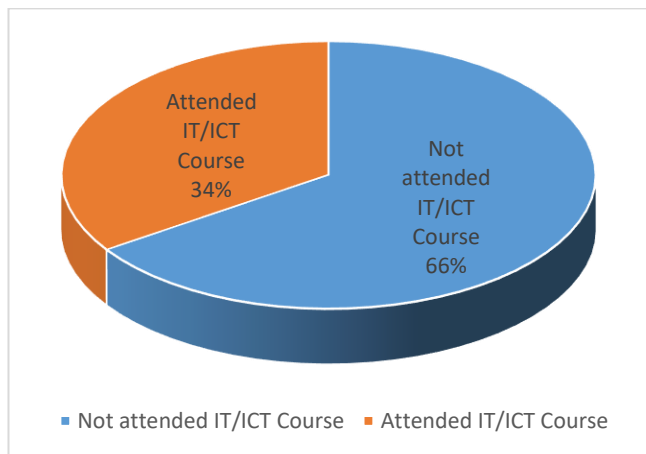
28

Figure 5.5: Teachers who attended IT/ICT Training

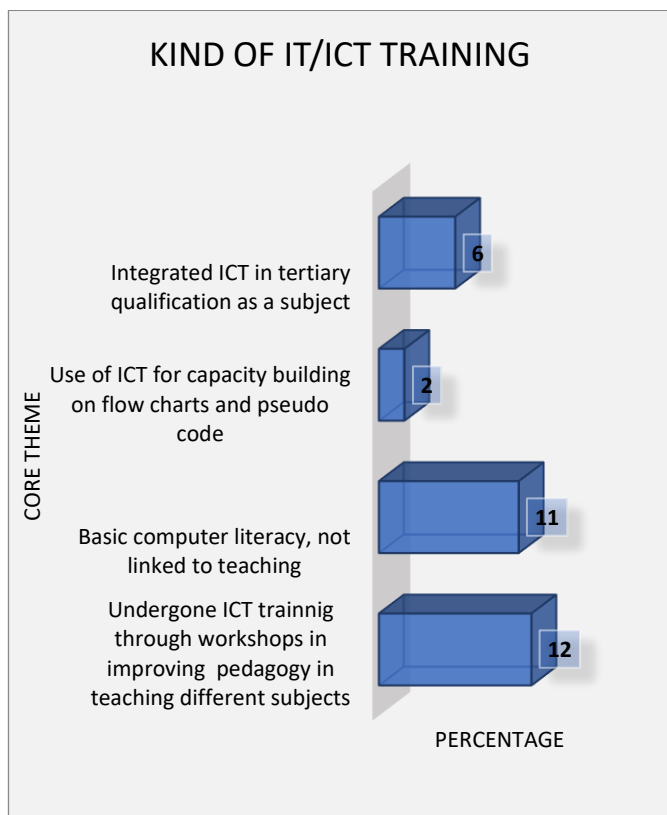## 4.2.1.7 Kind of IT/ICT Training or Course Attended by Teachers

Figure 5.6: Kind of IT/ICT Training

4.3 System Implementation Results

This part focuses on implementation and testing of the system. The implementation part, explores different parts of the system, how they were implemented and their function. The testing section of this part of chapter focuses on usability and functional testing to verify if the app attains the objectives of the proposed solution.

4.3.1 Implementation

The app developed analysis is based on the feedback given by some of the participants from the nine secondary schools where the survey had been conducted. It comprises of two sub-systems. One web back-end comprising system administrator and the mobile android application. They are outlined as follows:

4.3.1.1 Web Based System

The web back end is made using a bootstrap template that comprises of JavaScript, CSS, Json, and html files. For the back-end to work with the application, PHP scripts were created to connect to the database. The android mobile app and the back end share the same connection files and database which was created using MySQL. This was to make sure that the data visibility in both ends was the same. CSS, Json and JavaScript codes were used for the design on the user interface and PHP scripts were used to connect the applications in the database. The web-based system is mainly employed in the research for managing and controlling the entire system. The web-based system includes:

4.3.1.2 System Administrator

The system administrator gets to verify information entered by the school supervisors, teachers and class monitor or student, he is able to deactivate and activate school, enrol a user and display the information of the school to the users. The system administrator controls most of the actions in the system. After the user registers or is registered, they have no authority to input school details or edit

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before the system administrator enrols them in the system. This is necessary in order to verify that the user and the school are valid.

4.3.1.3 Activating and Deactivating the Users

The system administrator is able to activate and deactivate a user in case they give illegitimate information or misuse the system.

4.3.1.4 Mobile Android Application

This application is dynamic in such a way that all the information displayed is fetched from the database. All the data is stored in MySQL and through this a connection between the android app the database is made. Android uses Java and XML. The Java side was used to give the app functionality while the XML was used in creating the interface.

4.3.2 System Testing

Testing is usually a quality gate and the question and answer test group often serves as the quality gate keeper. Waterfall testing was used in the research which involved testing software for bugs and performance issues. This section therefore, covers testing of the mobile app to ensure that it works well, the testing was divided into two sections, developer testing and user testing. The first tests done by the developer were to ensure that the various functionalities were working well, the tests included:

4.3.2.1 Installation and Compatibility

Installation testing was done on a phone that has never had the app installed in it, this was to ensure that the app wouldn't have any issues when the users downloaded it from the website or store for instance. Then Compatibility testing to ensure that the app runs on all device versions, this would ensure that users with different Android API level phones would all get to use the app with ease. Table 3 shows the results of the test;

Table 3: Installation and Compatibility Testing

Test Case Name: Installation and Compatibility Testing Date Tested: 2nd May 2019 Tested by: Shadreck Mushisha Test Description: Installation and Operations of the Application				
Pre- Condition:				
Post- Condition:				
Test Steps				
Steps	**Actions**	**Expected Response**	**Pass/Fail**	**Comment**
1.	Application installation	Application is installed	Pass	Installed successfully
2.	Check if the application is running well	Application runs well	Pass	None
3.	Repeat step 1 and 2 on multiple phones with different API levels	Installs and runs well	Pass	None

Source: Author's Construct, 2019.

4.3.2.2 User Testing

After the researcher finished his testing, the study sought to see the reaction of the users to the application. Respondents were given instructions on how to install and have the app running on their phones.

4.3.2.2.1 Relationship between the use of App in Teaching and Teaching Methods

Teachers were also invited to assess the extent to which the use of SPMAA in teaching affects their practice.
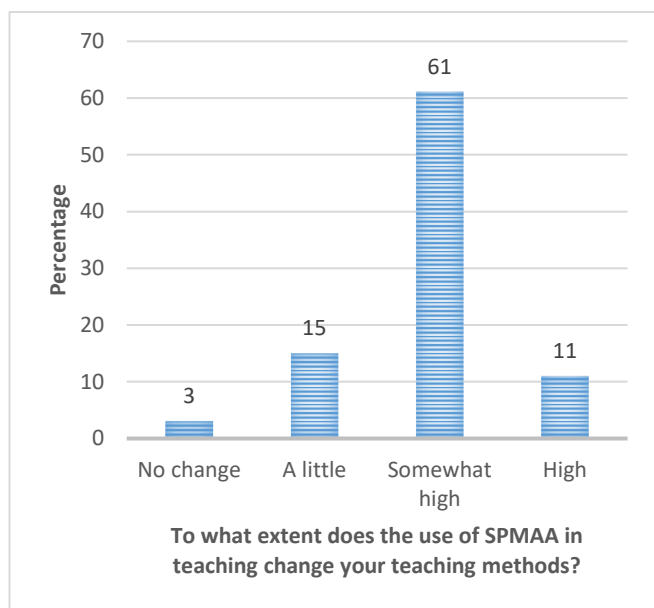

Figure 5.7: Relationship between the use of App in teaching and teaching methods

To measure the impact of their constructs on SPMAA service adoption, the respondents were asked to specify their degree of agreement with statements (measurement items). Here, the responses had shown in figure 5.8 that a minimum number of 3 teachers believed that there was *No change* or difference noticed in learner performance when the app was integrated in learning and teaching methods. 15 teachers said that there was *A little change* among the learners, 11 teachers indicated that there was a *High change* while the highest response of the teachers showed *Somewhat high* with a number response rate of 61.

4.3.3 Usability

The dissertation sort to see if the app was easily understood and the users could interact with it without the need for someone to explain how to use it. The dissertation shows the response from users with regards to their interaction with the app (table 4).

4.3.3.1 Perceived Usefulness of SPMAA in the Teaching Process

The determination of the perceived usefulness of SPMAA in the teaching process from schools under the study contributes to identifying both the advantages (in order to strengthen them) and disadvantages (in order to avoid and solve them). Arithmetic averages related to skills of using the tool and its applications were calculated as shown in table 4.

Table 4: Perceived Usefulness of SPMAA in the Teaching Process

No.	Perceived usefulness of SPMAA in the teaching process	Mean	Standard deviation	Mode	Agree (%)	Strongly agree (%)	Neither agree nor disagree (%)	Disagree (%)	Strongly disagree (%)	Comment
					1	2	3	4	5	
1	SPMAA can enhance teacher and pupil interaction	3.96	0.793	4	55	23	17	4	0.6	Maximum
2	SPMAA makes teaching more interesting for the teacher	4.18	0.824	4	46	38	12	2	1.2	Maximum
3	SPMAA makes teaching more difficult	2.21	1.032	2	11	3	18	43	26	Minimum
4	SPMAA can offer opportunities to teachers for obtaining learning resources to improve lessons	3.95	0.983	4	49	29	13	5	4	Maximum
5	SPMAA decreases students'' motivation	2.34	1.229	1	14	6	20	29	31	Medium
6	SPMAA improves the presentation of material in lessons	4.07	0.868	4	48	33	14	4	2	Maximum
7	SPMAA makes preparing lessons quicker	3.49	1.066	4	40	16	27	13	5	Medium
8	SPMAA limits the content of lessons	2.89	1.216	2	23	11	25	29	13	Medium
9	SPMAA makes preparing lessons more difficult	2.81	1.153	2	23	8	25	32	12	Medium
10	SPMAA makes the lessons more fun for the students	3.78	0.968	4	47	22	21	7	3	Maximum
11	SPMAA makes it more difficult to control the class	2.49	1.068	2	13	5	27	38	18	Medium
12	SPMAA may often prevent teaching because of interruption in work or in software	3.09	0.977	3	31	5	38	19	6	Medium
13	SPMAA will give teachers more confidence to extend their use of ICT to other topics	3.86	0.852	4	53	21	22	3	2	Maximum

Source: Author's Construct, 2019.

4. 4. Summary

The responses from the study were encouraging especially the usefulness of the mobile system and its functionalities which proved effective in enhancing the monitoring of quality subject progress in secondary schools in Luanshya District. However, the results of the study were able to unearth the problems and issues which require further attention in order to make it effective in its application. The study established that majority of the target population were enthusiastic about the value of the system. The usability study was equally encouraging but there is more room for improvement of system. However, since the system work with other system or software hence its operation might be affected by factors inherent in that system, but it's noteworthy that systems are in a continuous process of development.

CHAPTER FIVE

DISCUSION AND CONCLUSION

5.1 Introduction

In our country or outside our country many people want mobile based learning apps that will be easily accessible. Keeping this in mind, the researcher made a questionnaire document form regarding the Subject Progress Monitoring Android Application (SPMAA) software with some important questions and adopted survey through 9 secondary schools. 90 respondents filled up this survey.

5.2 Discussion

5.2.1 Survey Results and Discussion

5.2.1.1 Analyzing the Teacher Response by Gender

Figure 5.0 reveal that majority of teachers in the schools who were respondents to the study were female while a few teachers were male. Hence, there was a gender balance in the study since the country's constitution encourages female participation in every group of persons.

5.2.1.2 Age Distribution of the Teachers

Data in Figure 5.1 shows that majority of the teachers were within the age range 40 years and above, a few teachers were within the age range 35-39, 31-43, 26-30, 21-25 years and only 6 teachers were within the age range 16-20. It is therefore necessary to state that most secondary schools are full of teachers within the age bracket 40 years and above. This indicates that teachers have enough experience to ensure the implementation of SPMAA integration in their respective schools.

5.2.1.3 Level of Education Attained by the Teachers

Information in the bar chart (figure 5.2) reveal that majority of teachers had undergone tertiary Education. These findings indicate that Secondary Schools in the district are run and managed by teachers who have relevant professional qualifications and can therefore adapt to the changes posed by SPMAA integration in their schools.

5.2.1.4 ICT Tools Available in Schools

Results in the pie chart (figure 5.3) reveal that majority of the schools had phones/smart phones, which were readily used to communicate with students' parents either directly or indirectly through the use of email as well as Internet browsing to obtain teacher resources. On the other hand, majority of the schools indicated to have available laptops and desktops. A few schools reported that they had available and adequate film projector. Majority schools reported that they had no fax machines, only a few schools indicated using information contained on the hard drive or compact disc. Few schools indicated that scanners, routers, cameras, led monitor were available and inadequate. Majority of the schools reported that printers, televisions, radios, were available and inadequate. A few schools reported to have available and DVD players. Majority reported that calculators were available and inadequate. A few schools indicated that modems were available and adequate. Therefore, the results signified moderate use of hardware tools by teachers in their schools.

5.2.1.5 Accessing the Internet by Teachers

As shown in pie chart (figure 5.3), majority of the teachers were able to access the internet. This shows that majority of teachers in the secondary schools are ready to use SPMAA in teaching and learning on the other hand, the observation, schedule revealed that teachers relied on eternal support or improvisation to achieve this access to

the internet through their individual phones/smart phone, modems, iPad and laptops.

5.2.1.6 Level of ICT Usage in the Schools

The teachers were asked to indicate the level of ICT usage in teaching and learning (figure 5.4). 5 teachers (6%) indicated Maximum use ICT in teaching and learning. While 27 (30%) indicated Average use of ICT in teaching and learning. Majority of the teachers 58 (64%) revered Minimum use ICT in classrooms. This implies that an increasing number of teachers have not embraced integration of ICT in education hence the nation's development with earlier warning cited by (Okebukola, 2000) that the low ICT capacities of teachers would have serious implications for the nation's development efforts.

However, the research discovered that ICTs are used across the curriculum in the nine schools. The research established that ICTs are used for teaching, learning and administrative purposes. Research shows that teachers tend to teach the way that they were taught. The study provided evidence that in the nine schools teachers teach using constructivist methods. In light of the above, Vrasid and McIsaac (2001) say that if we expect teachers to teach in a constructivist way using technology, we need to be teaching and training them in constructivist ways using technology.

In this case, it does not matter then, where the school is located whether rural or urban. The integration of SPMAA in teaching and learning is very efficient and effective and will revolutionise the education system. Evidence from the findings revealed that in all the nine schools, ICTs have been integrated in the curriculum due to the many benefits they have. Teachers particularly highlighted that with the integration of ICTs the curriculum is more effective. This is important because it equips pupils with the ability to be critical thinkers and problem solvers. The findings

above are supported by Khosla (2013) who points out that ICT integration in the curriculum helps learners develop cognitive learning abilities and problem-solving skills by providing access to interactive enquiry- based learning resources. Secondly, it trains teachers to become facilitators of learning rather than sources of knowledge. However, the use of ICTs could be extended to co-curricular activities such as clubs and sports which, was not the case according to findings of the research in the nine study sites.

5.2.1.7 Teachers who had attended ICT/IT training or course

Findings in figure 5.5 shows that majority of teachers had not attended an ICT course or training. A lot of teachers had not attended an ICT course or training. However, quite a moderate percentage of the teachers had attained ICT training and hence, are ICT literate.

5.2.1.8 Kind of ICT/IT Training or Course Attended by Teachers

Results in bar chat (figure 5.6) reveal that majority of teachers had attended a training whose core theme was through workshops in improving pedagogy in teaching different subjects. A few teachers had attended a course on the use of ICT for capacity building on flow charts and pseudo code because this training course was strictly for that teaching mathematics. While others had attended training during their tertiary education where ICT was part of their course content as a subject and others had basic computer literacy training, not linked to teaching. These findings indicate that majority of the teachers are computer literate.

These results concur with the e-learning Nordic study 2006 results that suggest that more teachers are becoming computer literate to meet the demands of the 21st century. The findings provide strong evidence that the use of ICT in improving

teaching and learning has not been fully embraced by secondary school teachers. This trend may influence teachers' pedagogical approaches to teaching and learning and thereby students' attainment (Belta, 2003).

5.2.1.9 Availability of ICT Specialists in Schools

Data in figure 5.6 also indicates that majority of the secondary schools had few ICT trained personnel. Majority of the schools therefore did not have enough ICT specialists. This calls for comprehensive policies enhancing schools to have ICT specialists who can provide technical support to ICT beginners to broaden access to computer to enhance quality and develop pupils' knowledge and skills responsive to changing learning opportunities. It is worth mentioning that efficient ICT use has the potential that can indeed foster new learning environment with improved learning outcomes.

5.2.1.10 Relationship between the Use of App in Teaching and Teaching methods

Teachers were also invited to assess the extent to which the use of SPMAA in teaching practice affects their practice. Results in figure 5.7 indicates that teachers believe that there is a positive relationship between the use of SPMAA and its application and the nature of their teaching methods. Here, the responses had shown that a minimum number of 3 teachers believed that there was *No change* or difference noticed when SPMAA was integrated in teaching and teaching methods. 15 teachers said that there was *A little change* among the learners, 11 teachers indicated that there was a *High change* while the highest response of the teachers showed *Somewhat high* with a number response rate of 61.

5.2.1.11 Perceived Usefulness of SPMAA in Teaching Process

The results from Table 2 indicate that the highest advantages for implementing SPMAA in the teaching process was that SPMAA would make teaching more interesting for teachers, where the arithmetic mean was 4.18 with standard deviation of 0.824, implying convergence amongst teachers. The mode was 4 which indicates that the highest response was „*Agree*‟ with a percentage response rate of 46.2%. Secondly, was that SPMAA will improve the presentation of material during lessons‟ was the next advantage, with a mean of 4.07 and standard deviation of 0.868, implying convergence amongst teachers. The mode was 4 which indicated that the highest response was, *Agree* "with 48.3% of the teachers.

The most significant disadvantage given by the teachers that could arise as a result of using the app in the teaching process was that SPMAA could often prevent teaching because of interruption in work or in software where the arithmetic mean was 3.09 with a standard deviation of 0.977. The mode was 3 which indicated that the highest response rate was, *Neither Agree or Disagree*, with a percentage response rate of 38.4%. The next most significant drawback shown in the results was that SPMAA will limit the content of the teacher's lessons‟ with a mean of 2.89, a standard deviation of 1.216 (implying a high level of divergence) and a modal group of 2, or *Disagree*, with 29% of teachers sharing this viewpoint.

5.2.2 Baseline Study

Currently, research done through the researcher's observation in the field revealed that most institutions use manual systems that have little and no verification making them subject to abuse. The mobile application ensures that the lessons entered into the system have been covered as it requires verification by the learner to verify what the subject

teacher had entered. Apart from verification, the application also introduces participation of the learner in his/her learning progress. Being a digital Platform, the subject progress monitoring mobile application will offer readily available information which could be easily retrieved or even transferred onto other digital applications and platforms. The other benefit of the system is that it could be easily implemented in both urban and rural areas as it only requires an android smart phone.

5.2.3 Use of Technology

a. **Verification:** The main goal of subject progress monitoring mobile app software is to track the subject Teacher's progress in his or her attempt to complete the schemes of work. This information is vital as it will help the Subjects head make informed decisions as he/she will know what the students have been taught. The mobile application ensures that the objectives of lessons entered into the system have been covered as it requires verification by the learner to verify what the subject teacher had entered.

b. **Easily accessible:** The other benefit of the app is that it can be easily implemented in both urban and rural areas as it only requires an android smart phone. However, this android mobile application is designed to work as a single unit or also be integrated into larger systems, if the institution requires it. For using this app, you do not have to go through any complicated process of official registration. If a school decides to adopt this system into their established structure, their database of department subjects, faculties will automatically be imposed on this app's database. From thereon, all you need to do is collect your pre-set password from the administrator and sign in to the app. An authentication entry will be created for you, along with a unique user id.

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c. **Reduced cost:** Many of the supervisors do not reside at a place in the close proximity of the school premise that they are supervising. Thus, when they need certain information from the official files and folders, they have to find themselves a means of transportation just to access that file or folder. Thus, finding all that information at the palm of their hands through this app will greatly reduce the total cost of their daily trips. A mere connection to their local Wi-Fi will guarantee the availability of all those data on their android mobile phone in a matter of seconds.

d. **Saving time:** This app brings all the relevant information of your subjects, records and more to your mobile phone saving a lot of precious time. You do not have to wait to reach the establishment or wait for someone to send you the files to access all those data. You can do more with your time because of this app.

e. **Real-time updates:** The app will be synchronized with the database and the file storage at all times. Hence, whenever you open or operate the app, you will be getting all the updated data and materials in real time.

f. **Interactive environment:** One of the best features of today's smartphones and apps is the exceptionally interactive mobile environment and user interface. The elements of this app will go through smooth transitions when interact with it by pressing a button or swiping through activities.

g. **Simplified learning process:** Often we cannot process all the information and references introduced by the faculties in a classroom. Apart from verification, the application also introduces participation of the learner in his/her learning progress which is easy to operate or user friendly.

h. **Amplified availability;** Being a digital platform, the subject progress monitoring mobile app will offer readily available information which could be easily retrieved or even transferred onto other digital applications and other platforms.

i. **Centralized learning:** To ensure the proper management of all subject materials, updates and other necessary aspects of the overall learning process, this app will offer a solution to supervise over all these facets from one centralized system. This system will hold a centralized database, files storage, authentication process and more to make sure that all the entities involved get top-notch services.

5.2.4 Development of the System as a Solution

The dissertation will be significant to the ministry of education, teacher service commission, and supervisors of various secondary schools as they will be able to use the dissertation results to review teaching and learning activities or processes for the purposes of monitoring and evaluation of staff performance. The Subject Progress Monitoring Mobile Application Software is an android based mobile application which is designed to help institutions monitor the progress of a particular subject in a secondary school as covered by the Subject teacher. The subject teacher will be required to record his/her lessons by entering the lesson title and Lesson objectives into the Mobile application. Whilst, a selected student (pupil) will be required to verify whether or not the lesson and the objectives were taught in a particular period. This information will be checked by the subject supervisor (head Of Department) or the Deputy Head, depending on the policy of the Secondary School. The main goal of Subject Progress Monitoring Mobile application software is to track the subject Teacher's progress in his or her attempt

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to complete the schemes of work. This information is vital as it will help the Subjects head make informed decisions as he/she will know what the students have been taught.

5.2.5 Comparison with other Similar Works

The subject progress monitoring android app will be relevant as it will evolve around the school. It will focus on other factors such as co- curriculum activities to the verification and evaluation of the entire staff performance in terms of teaching and learning activities hence making it more reliable that other applications that have been developed which only focus on learners learning abilities without monitoring the student learning progress i.e. GoFormative (https://goformative.com/); Quizalize (https://www.quizalize.com)etc. It being a mobile application will make the school information more diverse since most individuals can access mobile phones.

5.2.6 Possible Application

The user of the subject progress monitoring mobile application will be able to login into the application and enter create subjects; enter lessons and lesson titles. The users will be able to search for lessons and verify those lessons or not. The ability to accomplish these tasks will depend on the privileges (permission) granted by the system administrator of the Mobile application will have granted the user. The search results will be in a list view and with option of tick yes or on a particular choice.

5.3 Summary

SPMAA is a mobile application that is designed to monitor the progress of a particular subject by observing which lesson objectives are covered. The Application use four types of users including Student, teacher, Administrator and Supervisor users. Each user as a specific role including:

creating users; creating lesson objectives; verifying the created lesson objectives; and viewing the verified lesson objectives. To accomplish its development, the application was created using the waterfall methodology of development. The application resides on an android operating system; however, it uploads its data on a remote database on a server via the internet. This remote database acts as the source for the four users for data entered created. From the results of the study, it is also important to appreciate that there are considerable pockets of respondents enthusiastic and ready to adopt and use the system, however this cannot be concluded with certainty as to the level of adoption and use because of various contextual environmental aspect in most schools in Luanshya District. However, the research results provide a good indication of the target user's willingness to adopt and use the system.

5.4 Conclusion

The linking of computers to education across the world is known to many people because it is believed that SPMAA has a crucial impact on teaching and learning. Hence, Educational Institutions are witnessing a paradigm shift brought about by the use of ICT that others have even started seeing ICT as an indispensable tool in the teaching and learning process. As a result, the research findings revealed that students, are continually exposed to the capabilities of ICT, their perceptions towards change.

The teacher's involvement in use of and perception have also change positively towards use of ICT in teaching and learning. It is evident from the findings in the study that some schools that have put more effort to integrate ICT in teaching and learning. With this, teachers are faced with the responsibility to utilize ICT. Here the researcher concludes the documentation by acknowledging the limitations and difficulties faced during the

development of this project. Also, the researcher hint at the future aspirations he has for this app and a rough estimation of ways to achieve them. Even though there are many apps with similar motives as this one (SPMAA), none of them have successfully been able to provide the users what they claimed. So, the researcher's main aim in future will be to overcome all those boundaries and difficulties, and create a proper educational app which can solve all the problems of students and supervisors simultaneously.

5.5 Future Works

- Enabling additional features (e.g.: using Bluetooth in sharing information unlike the use of school web system).

- Ensuring proper interaction and access control between user groups.

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REFERENCES

[1] Almekhlafi, A. G., & Almeqdadi, F. A. (2010). '*Teachers' Perceptions of Technology Integration in the United Arab Emirates School Classrooms.*' Educational Technology & Society.13 (1): 165–175.

[2] Ayas, C. (2018). '*An Examination of the Relationship between the Integration of Technology into Social Studies and Constructivist Pedagogies.*' The Turkish online Journal of Education. 5 (1): 14-25.

[3] Blackboard Inc. (2015). *Mobile LearnTM (4.1.4) [Mobile application software]*. Retrieved from https://play.google.com/store/apps/details?id=com.blackboard.android&hl=en [Accessed 20 January 2017].

[4] Burgess F. T (2001) *A general introduction to the design of questionnaires and for survey research. pp. 1.* Retrieved from: http://iss.leeds.ac.uk/downloads/top2.pdf. [Accessed: 8th August, 2014].

[5] Cano, E.V. and Garcia, M.L.S. (2013). '*ICT Strategies and Tools for the Improvement of Instructional Supervision. The Virtual Supervision.*' The Turkish Online Journal of Education Technology. 13(1): 77-87.

[6] Digital Campus. (2016). *OppiaMobile Learning (6.0.2) [Mobile application software]*. Retrieved from: https://play.google.com/store/apps/details?id=org.digitalcampus.mobile.learning&hl=en [Accessed: 28 June 2017].

[7] Hennessy, S., Harrison, D., Wamakote L. (2010). '*Teacher Factor Influencing Classroom use of ICT in Sub –Saharan African.*' Itupale Online Journal of African Studies. 2 (1): 39-54.

[8] Hennessy, S., Harrison, D., Wamakote L. (2011). '*An Investigation of Appropriate new Technologies to Support Interactive Teaching in Zambian Schools.*' Itupale Online Journal of African Studies. 2 (1): 39-54.

[9] Isaacs, S. (2007). *Survey of ICT and Education in Africa: Zambia Country Report*. www.infodev.org. [Accessed: 8/15/2013].

[10] Ivan Kalas et al. (2012). *ICT in Primary Education: Analytical Survey*. Moscow: UNESCO Institute for Information Technologies in Education.

[11] Khosla, N. (2013). iSchool: *Transformative Learning in Zambia Classroom*. www.api.ning.com. [Accessed: 14/01/2015].

[12] Lam, Y., & Lawrence, G. (2002). '*Teacher-Student role Redefinition during a Computer-Based Second Language Project*: Are Computers Catalysts for Empowering Change?' Computer Assisted Language Learning. 15 (3): 295-315.

[13] Mikre, F. (2011). *The Role of information communication technologies in Education*. www.ago.info/index.php/.../article.../624. [Accessed: 17/03/2015].

[14] Mtanga, N., Imasiku, I., Mulauzi, F., Sitali, W. (2012). *Use of ICTs in Education: A Case Study of Selected Urban Based High Schools in Lusaka, Zambia*. The University of Zambia.

[15] Munassar, N. M. A. & Govardhan, A. (2010). *A Comparison between Five Models of Software Engineering*. International Journal of Computer Science Issues. Volume 7. (Issue 5). pp. 95. [Accessed: 25th June, 2014].

[16] Naidoo P. (2011). Intercultural Communication: *A Comparative Study of Japanese and South African Work Practice*. PhD Thesis, University of Zululand-South Africa. pp. 113. [Accessed: 12th April, 2014].

[17] Pelgrum, W.J. (2001). '*Obstacles to the Integration of ICT in Education: Results from a Worldwide Educational Assessment*.' Computers and Education. 37 (2): 163-178.

[18] Rouse, D. H. (2005). *Computers as Mind Tools for Schools: Engaging Critical Thinking*. Columbus: Merrill Prentice-Hall.

[19] Selwood, I. & Pilkington, R. (2005). Teacher Work Load: *Using ICT to release Time to Teach*. Educational Review. 57 (2): 163-174.

[20] Sommerville I. (2009). *Software Engineering. 9th Edition. Publisher*: Pearson Education, Inc. pp. 126. Retrieved from: http://www.SoftwareEngineering-9.com. [Accessed: 5th April, 2015].

[21] Tedla, B. A. (2012). '*Understanding the Importance, Impacts and Barriers of ICT on Teaching and Learning in East African Countries.*' International Journal for e-Learning Security. 2 (3/4): 199 -207.

[22] Wegmann, A. & Genilloud, G (2000). *The Role of "Roles" in Use Case Diagrams. pp. 1.* Retrieved from: http://dscwww.epfl.ch. [Accessed: 10th June, 2014].

[23] Zhao, Y. (2007). '*Social Studies Teachers' Perspectives of Technology Integration*.' Journal of Technology and Teacher Education. 15 (3): 311-333.

Appendix A: Product Algorithm

This is an overall step by step view of how the Subject Progress Monitoring Android Application (SPMAA) works in different aspects of the work:

1. If first_Use = true:
Prompt create User details
Else If first_Use = False:
Go to login Screen (authentication Activity)
2. For all Users: Authenticate by
-Email and Password
3. If user_role =Student:
Initiate student's List Option's Menu
Else If user_role= Teacher:
Initiate Teacher's List Option's Menu
Else If user_role= Supervisor:
Initiate Supervisor's List Option's Menu
Else If user_role= Administrator:
Initiate Administrator's List Option's Menu
4. If Enter objective is clicked:
-initialize Class and subject Option menu
- Load classes
-load subjects
If Submit is clicked:
-initialize lesson Objective Option menu
-save chosen class
-save chosen subject
-load date

If Submit is clicked:
-insert filled in data into database
5. If verify Objective is clicked:
-initialize Class and subject Option menu
- Load classes
-load subjects
If Submit button is clicked:
Initialize Verify Lesson Objective Menu
If Go to Date:
-load Lesson objective of Date Entered
If lesson Objective Check Box is clicked
Lesson Lesson Objective Status = true (verified)
Else If lesson Objective Check Box is clicked
Lesson Lesson Objective Status = false (unverified)
6. If view Objective is clicked:
-initialize Class and subject Option menu
- Load classes
-load subjects
If Submit button is clicked:
Initialize Lesson Report Menu
If Go to Date:
-load Lesson objective of Date Entered
If Lesson_Objective_Status = false
Lesson_Objective_text_Colour = Red (unverified)
Else if Lesson_Objective_Status = true
Lesson_Objective_Text_Colour = Black (verified)