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Education management information system for tracking students' academic progress in secondary schools: a case of Arusha region

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**EDUCATION MANAGEMENT INFORMATION SYSTEM FOR
TRACKING STUDENTS' ACADEMIC PROGRESS IN SECONDARY
SCHOOLS: A CASE OF ARUSHA REGION**

Anold S. Nkata

**A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of
Master's in Information Communication Science and Engineering of The Nelson
Mandela African Institution of Science and Technology**

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ABSTRACT

Worldwide, the application of the Education Management Information System in schools for administering academic activities is termed as a fundamental practice of delivering quality education. In developing countries including Tanzania, most secondary schools use manual systems for administering academic activities. The manual system leads to ineffective collection and dissemination of information required to support the formulation of educational sound policies of enhancing the practice of delivering quality education and parental involvement in monitoring students' academic progress. This study investigated the strength and weaknesses of the use of manual systems in administering schools' academic activities. Structured interviews and questionnaires were used to collect data from teachers, students, parents and education officers in the Arusha region. Data were analyzed and findings revealed that the manual system leads to poor parental involvement for students' academic achievement, poor delivery of quality education and low productivity of teachers. The study concluded by implementing an Education Management Information System that can effectively enhance the accurate and timely collection and dissemination of quality data required to support policymakers in planning and monitoring of academic activities of enhancing the practice of delivering quality education for sustainable development. Moreover, the study recommends further research on investigating the feasibility of integrating the Learning Management Information System into a digital system to improve the work productivity of teachers for students' academic achievement.

DECLARATION

I, **Anold S. Nkata**, do hereby declaring to the Senate of The Nelson Mandela African Institution of Science and Technology, this dissertation is my original work. It has not been submitted to any university or higher learning institution for the award of any degree.

Anold S. Nkata
Author

Date

The above declaration is confirmed

Dr. Mussa A. Dida
Supervisor

Date

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CERTIFICATION

The undersigned certify that, has read and hereby recommends for acceptance by The Nelson Mandela African Institution of Science and Technology, a dissertation entitled “Education Management Information System for Tracking Students’ Academic Progress in Secondary Schools: A Case of Arusha region” submitted in partial fulfillment of the requirements for award of the degree of Master’s in Information and Communication Science and Engineering.

Dr. Mussa A. Dida
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Date

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DEDICATION

I dedicate this dissertation to my wife and my daughters. All of them remained a source of inspiration and gratitude towards achieving this kind of success.

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LIST OF ABBREVIATIONS AND SYMBOLS

AJAX	Asynchronous JavaScript Extensible Markup Language
CSS	Cascading Style Sheet
DEO	District Education Officer
E-government	Electronic Government
E-mail	Electronic Mail
EMIS	Education Management Information System
ESDP	Education Sector Development Programme
GPA	Grade Point Average
HTML	Hypertext Markup Language
ICT	Information Communication Technology
IS	Information System
JS	Java Script
LMIS	Learning Management Information System
ME	Margin Error
MoEST	Learning Management Information System
MySQL	My Structured Query Language
PHP	Hypertext Preprocessor
PI	Parental Involvement
RDBM	Relational Database Management System
SaS	Software as a Service
SAT	School Academic Teacher
SEDP	Secondary Education Development Programme
SMS	Short Message Services
STI	Science, Technology, and Innovation
UI	User Interface
UML	Unified Modeling Language
WEO	Ward Education Officer
XML	Extensible Markup Language
Z	Z-Score

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

Globally, the significance of parental involvement for students' academic achievement is widely recognized as an essential tool for improving quality education for sustainable development (Kabir & Akter, 2014). The term parental involvement can be defined as a process whereby a teacher communicates with parents about a student's academic progress and school academic activities (O'Hehir & Savelsberg, 2014). In this study, the term parental involvement is being used to mean the action of involving parents in monitoring and tracking students' academic progress to improve the academic performance of students. Worldwide, various education scholars have recognized the significance of parental involvement in students' academic achievement (Harris & Goodall, 2017). Despite the significance of parental involvement for students' academic achievement, the practice of enhancing parental involvement in Tanzanian secondary schools leaves teachers with challenges (Joseph, 2016). Teachers end up getting frustrations when involving parents with school academic activities (Masabo, 2017). Social and economic activities limit parents to have ineffective monitoring and tracking of students' academic progress (Kuboja, 2019). Ineffective parental involvement in monitoring and tracking students' academic progress leads to the poor performance of students in national examination results (Kimaro, 2015).

The government through the Ministry of Education, Science, and Technology (MoEST) has taken various measures to address the problem of the poor performance of students' in secondary education examinations results. Among the measures taken by the government includes Tanzania's Transformation Journey (TTJ) and the program for Result (P4R) which aimed to increase the performance of the students in national examination (Arnott, 2016). Despite these efforts, the national examination results still affect a high number of candidates as most of them fail to join for further studies due to a marginal pass of division four and zero in national examination results (URT, 2018).

Different educational scholars have recommended schools to use digital technology to enhance parental involvement for students' academic achievement (Becta, 2015; Gu, 2017; Lewin, 2018). However, it remained unclear on how can digital technology be applied in schools of developing countries to effectively enhance parental involvement for students'

academic achievement and to improve the practice of delivering quality education for sustainable development.

This study used three constraints of information systems which are data, information, and knowledge to bridge the gap by developing and implementing a centralized education management information system (EMIS) that can effectively enhance parental involvement in monitoring and tracking students' academic progress using E-mail and Short Message Services (SMS). The system can significantly improve the work productivity of teachers, reduce paperwork and costs of administering school's academic activities, enhance the collection and dissemination of accurate and timely educational information required to support the formulation of educational sound policies of delivering quality education for sustainable development in Tanzanian secondary schools.

1.2 Statement of the Problem

In developing countries including Tanzania, most secondary schools use manual systems for collecting, storing and disseminating education information (Luena, 2015; Villanueva, 2015). The manual system contributes to the ineffective collection and dissemination of accurate and timely education information (Lewin, 2018). Ineffective collection and dissemination of accurate and timely education information lower the productivity of teachers and that of education officers (Barakabitze *et al.*, 2015).

The manual system leads to loss of data integrity and disclosure of student academic reports made by the student in the absence of parents during the collection and dissemination of academic reports (Nghambi, 2014). Moreover, the system contributes to the high cost of running school academics associated with the use of paper works in offices and poor parental involvement in monitoring and tracking students' academic progress (Jafarov, 2015).

Strengthening of cost-effective education management information system for monitoring and tracking students' academic progress in secondary schools remained a knowledge gap of improving quality education for sustainable development. This study bridged this gap by developing and implementing a centralized Education Management Information System that can enhance parental involvement in monitoring and tracking students' academic progress in secondary schools. The system will be used for administering school academic activities and in reporting students' academic progress using E-mail and SMS. Moreover, the system can significantly improve the collection and dissemination of quality data required to support the

formulation of educational sound policies for the delivery of quality education for sustainable development.

1.3 Rationale of the Study

Globally, rational decisions are made based on quality data collected from reliable sources of stakeholders (Gabrielle, 2006). Education officers include Ward Education Officers (WEO) and Districts Education Officers (DEO) who need quality data for supporting planning, monitoring, evaluation, and relocation of education resources in secondary schools (Pauw *et al.*, 2015). Moreover, schools require a reliable tool for collecting and disseminating accurate and timely education information to improve the quality of education (Aldarbesti & Saxena, 2014). Furthermore, improving the quality of education for sustainable development requires collective knowledge and innovative contributions from educational stakeholders (Ngozi & Dambo, 2014).

Social and economic activities are among the factor which contributes to poor parental involvement for students' academic achievement in Tanzanian secondary schools (Janeth *et al.*, 2019). A study conducted by Kimaro (2015) of investigating the impact of poor parental involvement revealed that ineffective monitoring and tracking of students' academic progress lead to unsatisfactory students' academic achievement. Due to technological advancement, this study justified a potential need of implementing a centralized Education Management Information in secondary schools to enhance parental involvement for students' academic achievement and to improve the system of collecting and disseminating educational information required to facilitate the delivery of quality education in Tanzanian secondary schools for sustainable development.

1.4 Objectives

1.4.1 General Objective

The main objective of this study was to develop and implement an Education Management Information System for enhancing parental involvement in monitoring and tracking students' academic progress in Tanzanian secondary schools.

1.4.2 Specific Objectives

The specific objectives of this study were:

- i. To analyze the strengths and weaknesses of the existing systems used by secondary schools for monitoring and tracking students' academic progress and collect the requirements of the proposed Education Management Information System.
- ii. To develop an Education Management Information System for enhancing parental involvement in monitoring and tracking students' academic progress.
- iii. To validate the Education Management Information System.

1.5 Research Questions

This research study intended to address the following questions:

- i. What are the strengths and weaknesses of the existing system used in secondary schools for monitoring and tracking students' academic progress?
- ii. How do we develop and implement an Education Management Information System for enhancing parental involvement in monitoring and tracking students' academic progress in secondary schools?
- iii. How can the Education Management Information systems enhance parental involvement for monitoring and tracking student's academic progress in secondary schools?

1.6 Significance of the Study

This study developed and implemented a cost-effective system that contributes a significant knowledge of applying digital technology in enhancing parental involvement for students' academic achievement. The study potentially:

- i. Adds body of knowledge on how developing countries can make use of digital technology to minimize costs of administering school academic activities.
- ii. Disclosed scientific knowledge of how to improve the work productivity of teachers for students' academic achievement.

- iii. Contributes scientific knowledge on how policymakers and other educational stakeholders can use digital technology to collect and disseminate accurate and timely education information for supporting educational sound policies.
- iv. Provide a clear framework of improving practices of delivering quality of education in developing countries for sustainable development.

1.7 Delineation of the Study

The Tanzanian education system of secondary schools is divided into an ordinary and advanced level. It consists of four years for the ordinary level and six years for the advanced level. At the end of each level, students are required to sit for the national examination to be awarded a certificate of secondary education examination (CSEE) after successful completion of an ordinary level and an advanced certificate of secondary education examination (ACSEE) after successful completion of an advanced level and ready to join for higher learning. All levels require candidates to pass the national examination to qualify to join for the next level of education (URT, 2015).

Most candidates who sit for the national examination fail to join for further studies due to a marginal pass of division four and zero. This situation affects the implementation and achievement of sustainable development goals (UNDP, 2016) and Tanzanian Development Vision of 2025 of delivering quality education (URT, 2010). This study focused on strengthening the education management information system of Tanzanian secondary schools by exploring the potential benefit of applying digital technology to improve the delivery of quality education and reduce the mass failure of students in national examination results which affecting a high number of candidates to join for the further studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Review of Theories and Concepts of Parental Involvement

Various theories and concepts of previous researchers highlight the significance of parental involvement for student's academic achievement (Beasley, 2015; Saxena, 2017). Past education scholars have positive perceptions of enhancing parental involvement for students' academic achievement using digital technology (Becta, 2015; Lewin, 2018). Moreover, teachers and parents also have similar theories on the significance of parental involvement for student's academic achievement (Kuboja, 2019). Despite these theories and concepts, it remains unclear as to how the school can potentially use the existing technology to enhance parental involvement for students' academic achievement.

2.2 Epstein's Model of Parental Involvement for Students' Academic Achievement

According to Epstein's model, parental involvement for student academic achievement consists of six types which include parenting for student education, communicating students' academic matters to the parents, involving parents for volunteering school academic activities, involving parents in schools management board, creating conducive learning environment and the school to collaborate with the entire community by sharing educational resources and services (Joyce *et al.*, 2018). Epstein's model focuses on contributing public knowledge on the potential significance of creating a learning environment for the students'. The model does not explain how ICT can be used to enhance parental involvement in monitoring and tracking students' academic progress. Enhancement of communication between teachers and parents for students' academic achievement is a knowledge gap for improving the performance of students in Tanzanian secondary schools. This model did not clearly explain how parents can be involved in monitoring and tracking students' academic progress including class attendance and students' behavior which can ultimately reduce students' dropout.

2.3 Evaluation of Parental Involvement Based on Demographic Information

This study acknowledged that parental involvement for students' academic achievement has different perceptions based on the culture and the originality of the individual in a particular

society or nation. In this respect, the study reviewed various concepts and theories of parental involvement for students' academic achievement based on various demographic factors which gender, ethnicity, education level, and family income.

2.3.1 Parental Involvement Concerning Gender

Findings of the previous scholars show that parental involvement of females in monitoring and tracking students' academic progress is higher than that of males (Hornby & Witte, 2010). In South Australia, a report shows that females are more close than males in monitoring and tracking students' academic progress (O'Hehir & Savelsberg, 2014). Furthermore, in Bangladesh, the parental involvement of females in monitoring students' academic progress is higher than compared to that of males (Kabir & Akter, 2014).

The same applies to Tanzania, female have high parental involvement in monitoring and tracking students' academic progress than the male that is due to social and economic activities (Kapinga, 2014). To have a gender balance of parental involvement in monitoring and tracking students' academic progress, the application of an education management information system for monitoring and tracking students' academic progress using E-Mail and SMS is the knowledge gap of involving parents for students' academic achievement. The education management information system should involve parents in monitoring and tracking students' academic progress regardless of gender and without affecting social and economic activities.

2.3.2 Parental Involvement Concerning Ethnicity

In developing countries including Tanzania, parental involvement in monitoring and tracking students' academic progress in rural areas is not taken into high consideration compared to urban areas due to the nature of social and economic activities of the societies concerned (Kuboja, 2019). In a society of the Maasai whose social and economic activities are animal keeping, parental involvement for students' academic achievement is not a priority (Joseph, 2016). Due to technological advancement, it is high time for secondary schools to utilize the available technology to improve the delivery of quality education for student's academic achievement.

2.3.3 Parental Involvement Concerning Education Level and Family Income

Globally, parental involvement in monitoring and tracking students' academic progress is affected by education level and family income (Harris & Goodall, 2017; Masabo, 2017). Families with satisfactory income used to enroll their children in private schools whereby parental involvement in monitoring and tracking students' academic progress is taken into high consideration compared to the public school (Kimaro, 2015; Taylor, 2015).

2.4 Implementation of the Education Management Information System in Tanzania

The plan for implementing an Education Management Information System in Tanzania started in 2004 (URT, 2010). The Education Sector Development Programme (ESDP) initiated the plan of implementing EMIS to use it at the ministry level in supporting planning and decision making (URT, 2010). However, the EMIS was not implemented at the school level. Since then, Tanzania's secondary schools still use a manual system for collecting and disseminating education information (Sedoyeka & Gafufen, 2016).

2.5 Application of Education Management Information System in Secondary Schools

In Tanzania, some private secondary schools use a web-based education system in administering school academic activities (Luena, 2015). However, the system was not meant to enhance parental involvement in monitoring and tracking students' academic progress. Most secondary schools use that system for keeping students' academic records and not for enhancing parental involvement in monitoring and tracking students' academic progress. Parents who live apart with their students and in charity school whereby supporters live

abroad still struggle to involve with school academic activities and in monitoring and tracking student's academic progress. Moreover, the system requires parents to visit schools physically collecting students' academic progress or school to send students' report by an enclosed envelope. The available education management information system in Tanzanian secondary schools lacks features of notifying parents by E-mail and SMS students' academic progress which includes class attendance, score marks, and students' academic discipline.

2.6 Review of Previous Research Findings

A study conducted in California to explore the knowledge of parental involvement for students' academic achievement using digital technology shows that most schools do not have parental involvement sensitization policies (Olmstead, 2013). Based on the findings, the study recommended schools to formulate parental involvement policies for students' academic achievement.

In developing countries including Tanzania, poor parental involvement is being caused by demographic factors such as education level, ethnicity, family income, social and economic activities (UNDP, 2016). Formulation of parental involvement policies cannot work in Tanzania secondary schools due to demographic factors such as social and economic activities of parents and family income. Instead, Tanzania secondary schools need a reliable digital tool that can be notifying parents of the academic progress of their students through E-mail and SMS at any time and everywhere. The system can allow parents to monitor and track students' academic progress without affecting their social and economic activities.

Past education scholars conducted a similar study of enhancing parental involvement for students' academic achievement using digital communication technology (Kemp, 2015; Olmstead, 2013). The study proposed schools to use social networks such as Face book, Mobile Application and Twitter to improve communication between teachers and parents to improve students' academic performance.

This study acknowledged the proposed technology of using social networks for enhancing communication of students' academic matters between teacher and parent. However, technology is not cost-effective for schools in developing countries due to budget constraints (URT, 2018). Application of Facebook, mobile application and Twitter may add costs in terms of money and time of teachers due to a big number of enrollments of students in Tanzania secondary schools. Also, the proposed technology cannot enhance effective parental

involvement in monitoring and tracking students' academic progress simply because not all parents own a smartphone for communication. Therefore, this technology cannot be convenient for Tanzania secondary schools since it requires teachers to have a smartphone and airtime for communication.

In Taiwan enhancement of communication between teachers and parents for student academic matters is done by using E-mail and Short Message Services (Chena, 2015). This study acknowledged technology, simply because the practice of improving communication between teachers and parents shapes students' discipline, school, and class attendance and reduces students' dropout (Nam & Park, 2014). In this respect, Tanzanian secondary schools require an automated education management information system not only for enhancing communication between teachers and parents but also for the collection and dissemination of accurate and timely education information required to support the formulation of educational sound policies for policymakers.

2.7 Research Gap

A research gap simply means missing knowledge from previous related works (Cohen & Keith, 2005). This study reviewed various theories, concepts, and findings of previous scholars of enhancing parental involvement for students' academic achievement using different digital technology such as the mobile application (Becta, 2015; Joy Caño *et al.*, 2016; Kimaro, 2015). Past scholars recommend schools to start using digital technology to enhance parental involvement for student's academic achievement. However, none of them disclosed scientific knowledge of how ICT can be applied in secondary schools to enhance parental involvement in monitoring and tracking students' academic progress for academic achievement.

Different technologies such as the use of social media and text messages to communicate students' academic matters were proposed by previous scholars (Olmstead, 2013). The proposed technologies found to add other costs to teachers and parents in Tanzanian secondary schools. Moreover, improving students' academic achievement has to go parallel with the practice of improving educational policies in Tanzania. In this regard, Tanzanian secondary schools need a reliable digital tool for enhancing communication between parents and teachers for student's academic matters and for collecting and disseminating accurate and timely education information for decision making.

The study bridged this critical gap by proposing Software as a Service (SaaS) technology to be used to implement a centralized Education Management Information System for monitoring and tracking students' academic progress in Tanzanian secondary schools. The SaaS was chosen based on a technical reason such as minimization of costs related to the installation and configuration devices and software. With the use of SaaS, there will be no need for schools to buy a powerful server machine and to have a public IP address. The technical approach reduces the total cost of ownership faced by numerous schools in owning the digital system for administering school academic activities. The centralized EMIS is expected to enhance communication between teachers and parents for students' academic matters using E-mail and Short Message Services. Also, to improve the productivity of teachers, education officers and to facilitate the practice of collecting and disseminating accurate and timely education information required to support planning, monitoring, and evaluation of the academic activities.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study was conducted in secondary schools of the Arusha region in the northern zone of Tanzania from January 2019 to August 2019. The region consists of seven councils which are Arusha municipal council, Arusha district council, Meru district council, Ngorongoro district council, Karatu district council, Monduli district council, and Longido district council. The region has two hundred thirty-six secondary schools of which one hundred and eighty are public secondary schools and fifty six are private secondary schools.

All secondary schools in the Arusha region used to seat for one regional, district and ward examination to compete for the academic performance of students. The purpose of this model of assessment is to provide competition for teachers to cover the curriculum and on delivering quality education for sustainable development. This practice has improved the performance of students of secondary schools in Arusha (NECTA, 2019; NECTA, 2018). The competitive and strategic efforts of improving the performance of students initiated by the education officers of Arusha is one of the technical reason which made this study to be conducted in Arusha region. Figure 1 shows the Tanzanian map with an extension of the Arusha region map.

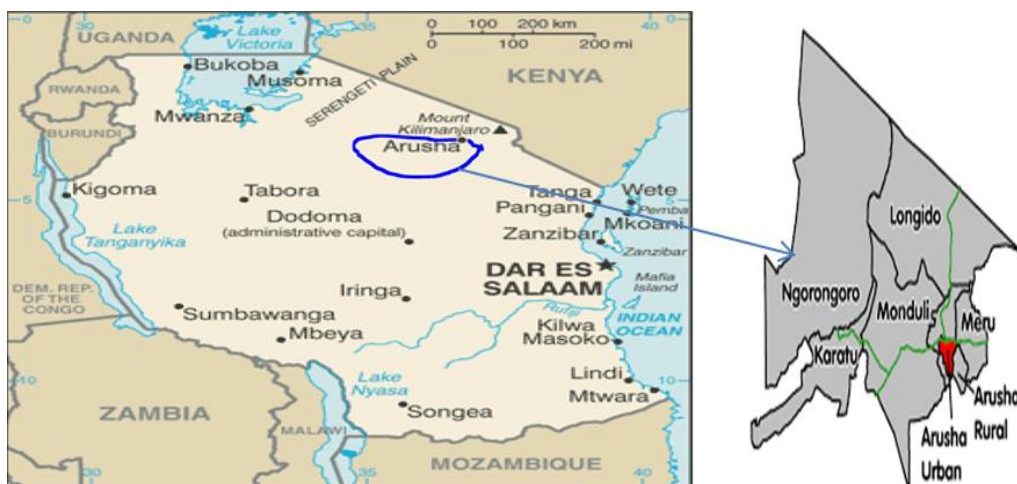


Figure 1: Tanzanian map contain Arusha region and its districts (The world facebook)

3.2. Consideration of Research Ethical Issues

This study considered ethical issues at every stage of research design. Research ethics is the moral behavior that involves a systematic way of conducting research activity based on the determination of what is good and what is bad for the people involved in research processes (Kumar, 2011). Teachers, students, parents, education officers and other school's education stakeholders who were involved in this study were ethically treated with high respect during data collection, analysis, and interpretation. Data integrity, confidentiality and privacy of respondents were honestly taken into ethical consideration and treated fairly for this study.

3.3 Consideration of Demographic Factors

The study used demographic factors such as the geographical location of the school, type of school, social and economic activities of residents in evaluating ICT infrastructure of secondary schools. Tanzanian schools are of two types which are public and private secondary schools. This study considered gender, ethnicity, education level of stakeholders and family income when investigating parental involvement in monitoring and tracking students' academic progress.

3.4 Research Methodology

A research methodology is a systematic procedure, techniques, and methods adopted for conducting a study for the aim of ensuring the validity and credibility of the research findings (Kothari, 2004). This study used various methods, tools, and techniques to obtain a sample size for data collection. To ensure validity, credibility, and reliability of the study, a systematic procedure such as formulation of the research problem, doing a literature review, formulation of research hypotheses, formulation of the sample, sample size, data collection, analysis, and interpretation were followed. Figure 2 below describes various phases of the research process used for this study.

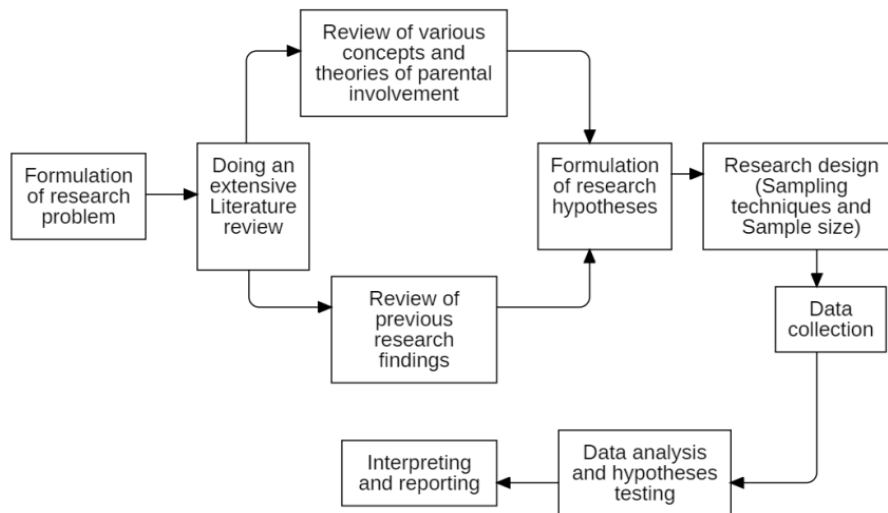


Figure 2: Research design and processes used by the study

3.4.1 Sampling Methods

Sampling techniques are a means of obtaining a sample of the representative from a finite or infinite population of the study (Mohsin, 2016). A finite population is a population whose size is well known while an infinite population is a population whose size is unknown (Cohen & Keith, 2005). According to Kothari (2004), sampling methods are grouped into probability sampling and non- probability sampling. Probability sampling consists of simple random sampling, systematic random sampling, stratified random sampling and cluster sampling (Mohsin, 2016). This study used simple random sampling techniques to obtain representatives of the study from an infinity population of students, teachers, parents and a finite population of education officers of secondary schools in the Arusha region. This sampling technique was chosen simply because every individual of the educational stakeholders was having an equal chance of being selected for the study.

3.4.2 Determination of Sample Size

The determination of sample size for data collection involved a practical way of choosing the number of representatives with consideration of the research budget and research time frame. This study collected data from an infinity population of secondary school education stakeholders of the Arusha region. The study used a Cochran formula

$$n = \frac{z^2}{me^2} p(1-p)$$

(Garcia & Gaurav, 2015) to obtain a sample size of one hundred and eighty representatives for data collection. The formula above represents the sample size, Z represents Z-Score. This study used a Z-Score of 1.645 for the confidence level of 90%, ME represents Margin Error, and the study used margin error 60%, p and represents a population proportion of 40%. To get accurate and validity of data from respondents, the study involved the high number of teachers compared to the other respondents. Table 1 shows the number of respondents used to form a sample size of one hundred and eighty respondents for data collection.

Table 1: Number of respondents used to form a sample size

S/N	Number of respondents	Total
1	Teachers	103
2	Students	50
3	Parents and Guardians	25
4	Education Officers	2
Total		180

3.5 Methods of Data Collection

The validity and reliability of data were taken into high consideration during data collection. In this respect, the study used a structured interview and questionnaires to collect primary data from secondary school's education stakeholders of the Arusha region. All respondents were given a similar set of structured questions that were prepared based on research objectives. The essence of getting accurate and updated information was among the factors which lead to collect primary data from the respondents.

3.5.1 Structured Interview

This study used structured interviews to collect primary data from teachers, Ward Education Officer and District Education Officer to identify and analyze an existing system used by secondary schools for collecting, storing and disseminating education information. After analyzing the existing system, the study aimed to collect the requirements of the proposed system. However, the study achieved the objective after conducting face to face interviews with school academic teachers, school discipline teachers, subject teachers, District Education Officer and Ward Education Officer. The structured interview data collection method was used purposely to enable the consistency of data collected from the respondent who asked the same type of question.

During face to face interviews, all challenges and shortcomings of the existing system were discussed. The purpose of identifying and analyzing an existing system used by secondary schools for administering school academic activities first was to investigate whether the existing system enhances parental involvement in monitoring and tracking students' academic progress. Secondly, it was to investigate whether the existing system effectively supports the collection and dissemination of accurate and timely educational information required to support the work productivity and that of educational policymakers.

3.5.2 Questionnaire

The study distributed a set of open-ended and closed-ended questions to teachers, parents, and students of Arusha secondary school to collect primary data. To maintain the reliability and validity of data, the study distributed similar types of questions to all respondents. The technical reason for using the questionnaire data collection method was to accommodate a high number of respondents to minimize costs in terms of money and time for data collection. To ensure maximum return, all questionnaires were structured in such a way that they could contain short and simple questions that reflected the interest of students, teachers, parents and education officers. Moreover, distributed questionnaires were effectively managed and administered to maximize the number of returns. Furthermore, all respondents were given full supports to express their ideas and their views on the impact of parental involvement on student academic achievement.

3.6 Data Analysis

Data analysis is an act of converting data into useful information to support the activity of decision making (Fielding & Pillinger, 2008). This study used the Pandas Python data analysis software package to analyze data and to visualize results obtained into diagrams. The inference was made based on data visualization and examined to reflect the impact of poor parental involvement in monitoring and tracking students' academic progress. The study examined the impact of using the manual system for administering school academic activities to examine the effectiveness of the collection and dissemination of educational information. Multiple features of data visualization contained in Pandas and convenient methods of data filtering were the technical reasons that made to choose Pandas to analyze data collected for this study.

3.7 Software Development Life Cycle

The software development life cycle (SDLC) is a structured framework that defined steps and tasks to be performed when creating an information system (Sommerville, 2011). This study adopted six phases of the software development life cycle to develop and implement a centralized Education Management Information System for monitoring and tracking students' academic progress in Tanzanian secondary schools. The six phases are requirement gathering, requirement analysis, systems design, system testing, system implementation, operation, and maintenance.

3.7.1 Requirements Gathering of the Education Management Information System

Requirement gathering is an activity of conducting system re-engineering to collect systems requirements (Mustaquim & Nyström, 2015). This study collected functional and non-functional requirements of the centralized Education Management Information System for developing and implementing a cost-effective digital of enhancing parental involvement in monitoring and tracking students' academic progress in secondary schools and for ensuring accurate and timely dissemination of education information.

3.7.2 Functional Requirements of the Education Management Information System

In software engineering, functional requirements of the system are the one which defines tasks and daily operational activities of the institution (Sommerville, 2011). Usually, functional requirements are collected from end-users of the system for system development. After the system has been developed, it has to be validated in the presence of users to confirm user acceptance of the system. Table 2 outlined a list of functional requirements of the centralized Education Management Information System which were collected and analyzed based on school academic activities.

Table 2: Functional requirements of the system

S/N	Functional requirements	Description
1	Login Module	System administrator, Teachers, Students, Parents, and Guardians, Ward Education Officer
2	System setup module	The system should manage school information: Department which are Arts, Business and Science
3	Assigning subject to teacher	The school academic teacher has to assign teacher a subject for teaching
4	Upload marks module	The teacher has to upload, view and print marks for the assigned subject
5	Student attendance	The system should keep student attendance uploaded by the teacher and easily track by parents and guardians
6	Student behavior	School academic teacher should be able to upload records relating to student behavior
7	Report generation	The system should generate a report for the student and user be able to view and print
8	Grading Module	Manage Marks, Grade, and positions of students in a class
9	Communication Module	Through E-mail and Short Message Services between parents, teachers, and students
10	Parent notification	The system has to send a notification message to the parent through E-mail in case the marks scored by the student is below the standard set by schools, and when it happens a student fails to attend class five times for one term of the academic calendar
11	Upgrade Module	Moving students from one class to another class
12	Students management module	Manage students' registration, personal information, contact, and academic information

3.7.3 Non-functional Requirements of the Education Management Information System

This study used requirements engineering techniques to collect non-functional requirements of the education management information system. Non-functional requirements evaluate the quality attributes of the system by defining system features required to enhance the security of the system, performance, availability, and scalability (Kendall, 2012). Table 3 shows a list of non-functional requirements integrated into a centralized Education Management Information System for monitoring and tracking students' academic progress and ensuring accurate and timely dissemination of education information.

Table 3: Non-functional requirements of the system

S/N	Non-functional requirements	Description
1	System security	The ability of a system to provide security measure against intruder such as keeping user logs, activity logs, change password, reset the password, session management and, administrator to perform system audit trail
2	System performance	Measurement of system response time and throughput
3	System usability	The degree at which the system can easily be used by users to satisfy their business needs
4	System availability	The ability of a system to be available to the only authorized users under normal operation
5	System reliability	The ability of a system to operate as it was designed without failure
6	Efficiency and maintainability	The system operates efficiently and the ability to be performed system maintenance
7	System recovery	The ability of a system to recover data upon system failure and when user forget password
8	System scalability	The ability of a system to handle scalability of data

3.7.4 System Analysis and Modeling

System modeling is the graphical representation of an information system (Mustaquim & Nyström, 2015). To make the functionality of the system to be clear and understandable to the users of the system, the study used Unified Modeling Language (UML) notation to present the blueprint of the system to the teachers of Arusha secondary schools. Among the stakeholders of the EMIS, secondary school teachers are the primary users of the system. This technical reason made the study to present the blueprint of the system to the teachers and not to the other users. In software engineering, UML is a visual representation of the system architectures (Stevens, 2006). The study created a blueprint of the system by transforming system requirements into the context-level data flow diagram. Figure 3 illustrates the context level 1 data flow diagram (DFD) of the EMIS. The EMIS consists of system components, entities, system processes and other UML notations such as data store and add note which describing system functionality of recording student behavior, class attendance, and for sending E-mail and SMS to the parents.

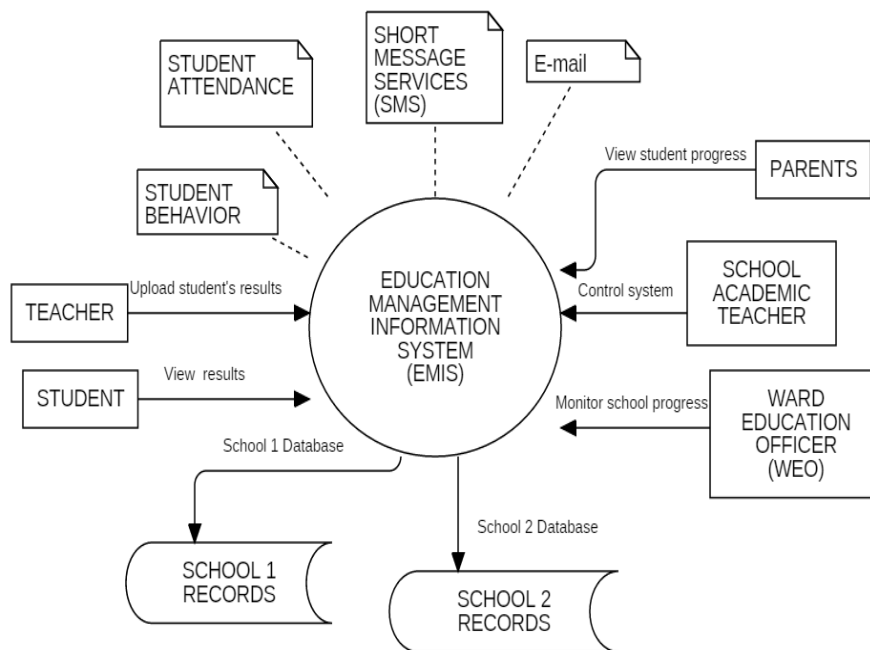


Figure 3: Context level 1 data flow diagram of the system

3.7.5 Use Case Diagram of the Education Management Information System

In the context of system modeling, this study used actors and use cases to visualize functionalities of the system into dynamic and behavioral actions that are performed by users of the education management information system. According to Stevens (2006), the use case diagram is defined as the dynamic representation of the system functionalities which used to describe the interaction with users. This study used UML notation to describe the interaction of the system with users. The system consists of five actors who are school academic teachers a system administrator whose responsibilities on managing the system, subject teacher, student, parent, and Ward Education Officer. Figure 4 consists of five actors and use cases that describe an interaction of users with the system.

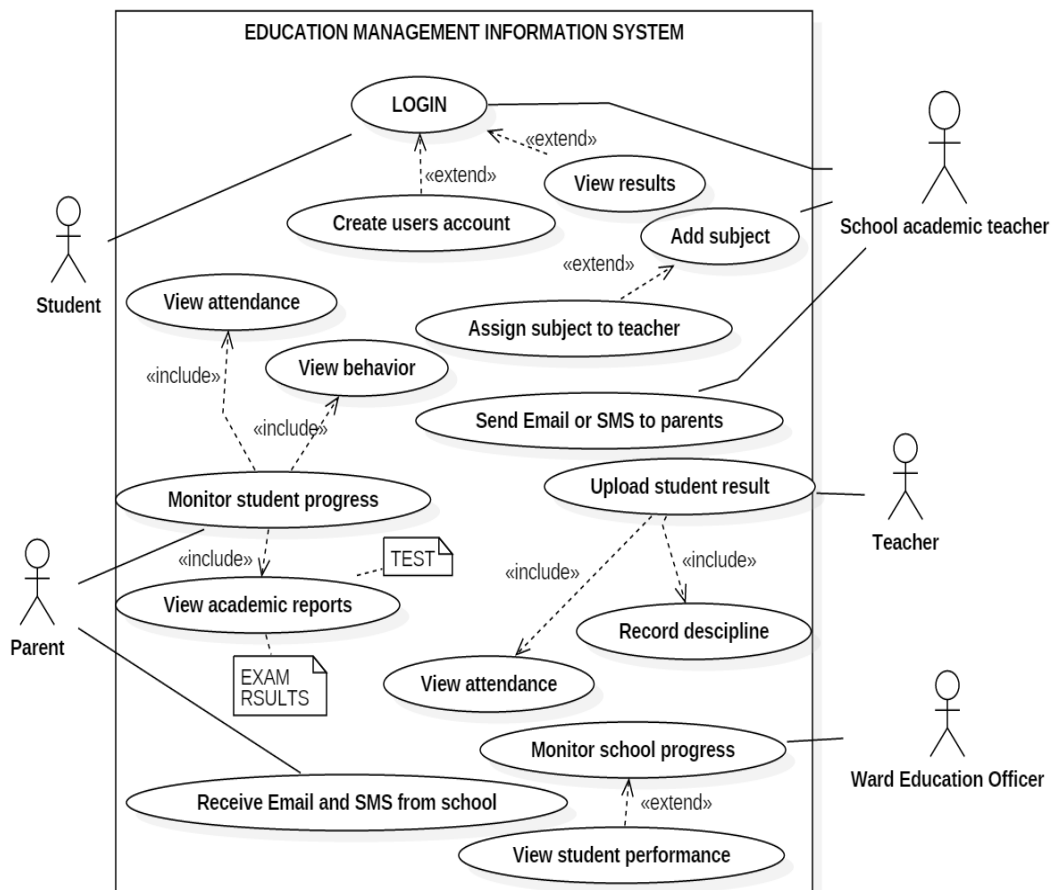


Figure 4: Use case diagram of the system

3.7.2 Database Schema

This study used MySQL Workbench to represent the logical view of the entire database of the Education Management Information System. The study briefly represents the schema of the database by showing the logical organization of the data, the relationship of entities and how the database of the system was constructed. However, in the relational database management system (RDBM), the term database schema usually refers to the blueprint of the database system (Begg, 2004). Figure 5 describes the logical view of the education management information system of the relational database system.

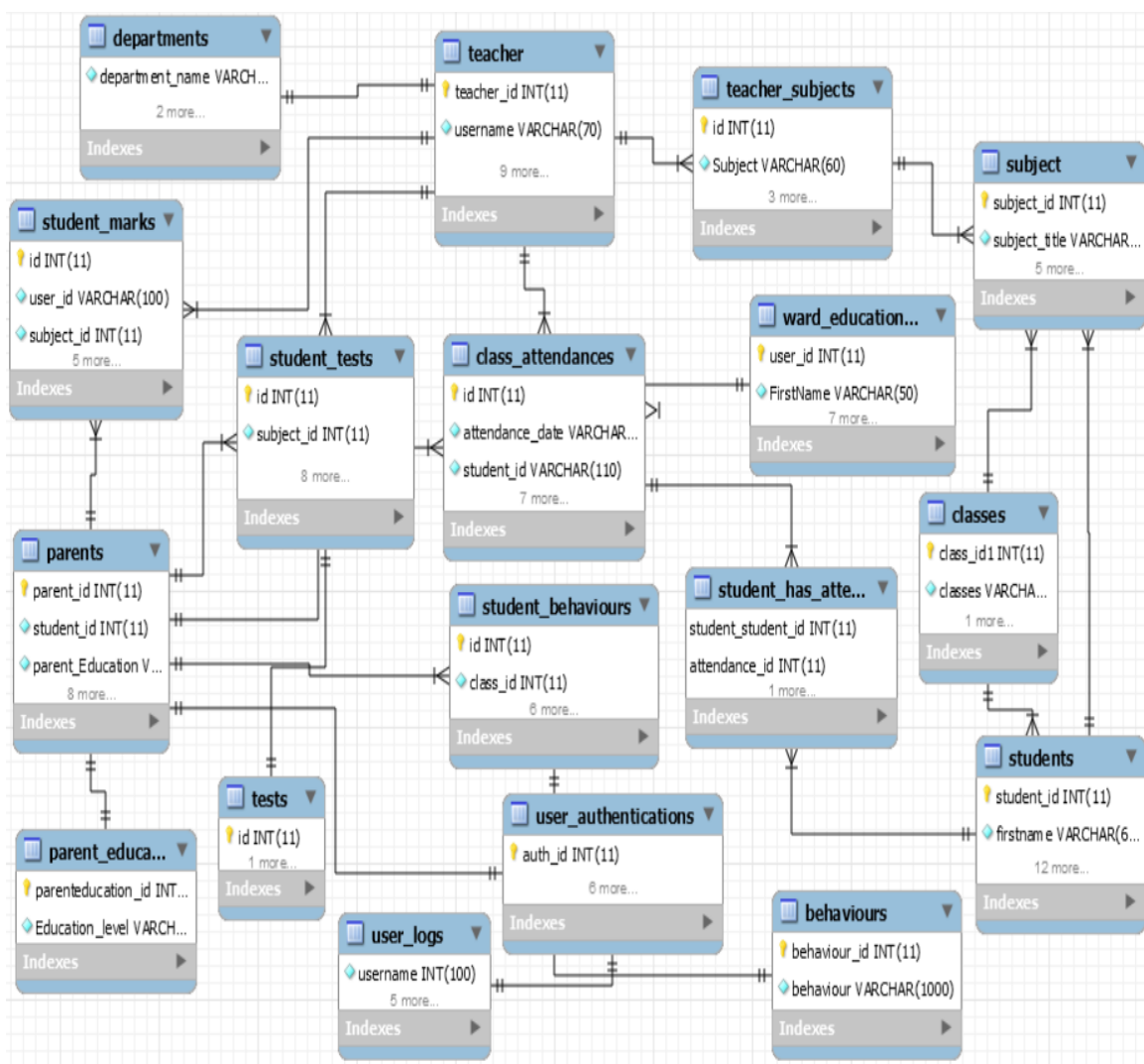


Figure 5: Logical view of the database system

3.8 System Development Methodology

To control and manage the process of designing and implementing an education management information system and to minimize costs in term of money and time, the study technically used an Agile system development methodology to allow interaction with the users of the system to facilitate the quick practice of fixing bugs and changing requirements. According to Georgiev (2014), Agile development methodologies consists of Scrum, Extreme Programming (XP), Crystal, Feature Driven Development (FDD), Dynamic Systems Development Method (DSDM), Adaptive Software Development Method (ASD) and Learn Software Development (LSD). This study chooses to use Extreme Programming (XP) among the group of Agile system development methodologies to enhance continuous feedback from users.

3.8.1 Technical Reason that Made to Use Extreme Programming

The primary goal of this study was to enhance users' satisfaction and reduce costs associated with system development and to accommodate the user's interaction and to encourage the user's input in a quick manner. The methodology helped to minimize costs in terms of time and money during the development processes of EMIS.

3.8.2 Iterative Development Techniques

To get continuous feedback from users, the study used iterative techniques to deliver subsystem in the form of user stories. This process was repeated in a life cycle manner until the end of system validation of user acceptance testing. Figure 6 describes an iterative technique used by this study to facilitate user interaction to receive quick feedback for further improvement.

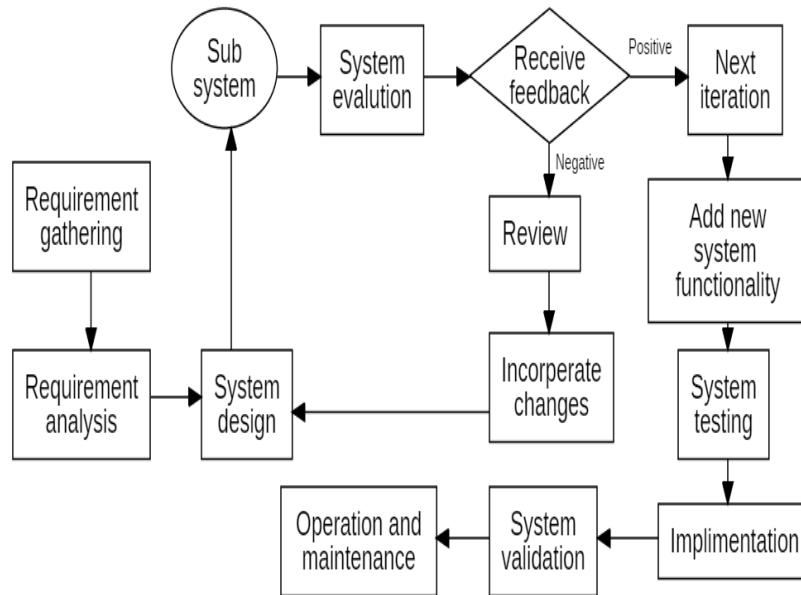


Figure 6: Iterative development methodology used by the study

3.8.3 Selection of Iterative System Development Methodology

The factors that lead to the selection of iterative development methodology are:

- i. To actively involve users of the system during the development process.
- ii. To get instant and frequent feedback from users to improve system functionality.
- iii. To be in a good position of identifying a missing system module.
- iv. To design a system based on user needs to simplify an exercise of system validation.

3.9 Web Development Language

The centralized EMIS for monitoring and tracking students' academic progress was developed and implemented using a server-side scripting language and client-side scripting languages. Web technologies such as HTML, PHP, and Bootstrap framework typography templates containing CSS and JavaScript were used to design forms, navigation components, system interfaces, and systems buttons. Moreover, the Application Programming Interface (API) was used to design the SMS API for sending and receiving SMS. Due to the sensitivity of education data, the database of the education management information system was

designed by using MySQL which was selected purposely due to the security features such as SQL injection security of protecting the EMIS from hackers.

3.9.1 Different between Server-Side and Client-Side Scripting Language

The EMIS was developed by using a combination of Server-Side Scripting and Client-Side Scripting languages. The Server-Side Scripting language involves Server to process the Scripts while Client-Side Scripting language does not involve Server to process the Scripts, instead, it requires the only web browser to process the Scripts. The study used both Server-Side language and Client-Side Scripting language to improve the performance of the system.

3.9.2 Description of Web Technologies used for Developing the System

The most used web programming languages for developing application systems are HTML, CSS PHP, and JavaScript. This study used HTML, CSS, PHP, and JavaScript to develop dynamic and interactive web pages of the centralized Education Management Information System. Table 4 lists web development technologies used by this study during the development of the system.

Table 4: List of web technologies used for developing the system

S/N	Tools	Description
1	HTML	The scripting web programming language. In this study, it was used to design and create structures of different web pages of the system
2	CSS	Client-side scripting web programming language. In this study, it was used to design page layout and to make a different style of web pages
3	AJAX	AJAX stands for Asynchronous JavaScript Extensible Markup Language. The AJAX contains features of XML & JavaScript. The AJAX was used for developing system features for enhancing system interactivity. For example system features of retrieving data from the database without refreshing the page
4	PHP	The server-side scripting language was used to make the dynamic and interactivity of web content applications
5	MySQL	Relational Database Management System (RDBMS) used to design the database of the EMIS and to secure the system using SQL injection
6	API	Used to design features required to support system functionality of sending and receiving SMS

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Review of an Existing System used for Administering Academic Activities

To identify and review various systems used by secondary schools in collecting, storing, processing and disseminating education information, the researcher collected primary data from one hundred and three secondary school teachers. In this respect, respondents were asked about what kind of systems do their school uses to report students' academic progress and for administering school academic activities. After data analysis, the study revealed that 98.30 % of secondary schools use a manual system for reporting and administering school academic activities. While 1.70 % uses both manual and office application programs such as Microsoft Excel for running school's academic activities. Figure 7 illustrates the findings of the data collected from teachers.

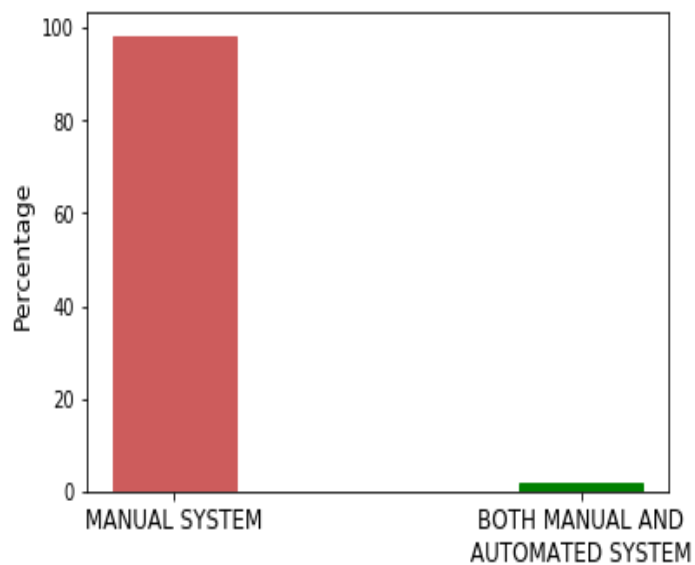


Figure 7: Systems used by secondary schools

4.1.1 Drawbacks of the Manual System

The study wanted to investigate the drawback of the use of manual systems towards the practice of enhancing parental involvement for students' academic achievement. In this respect, the study collected data from teachers, education officers and parents to determine whether the manual system enhances parental involvement in monitoring and tracking students' academic progress. After data analysis, 93.20 % of the respondents said the manual

system does not enhance parental involvement in monitoring and tracking students' academic progress. Only 1.80 % of the respondents said the manual system enhances parental involvement in monitoring and tracking students' academic progress. While 5.00 % of the respondents said they are not sure whether manual systems enhance parental involvement. Figure 8 illustrates the findings of the primary data collected from teachers, students, parents, and guardians.

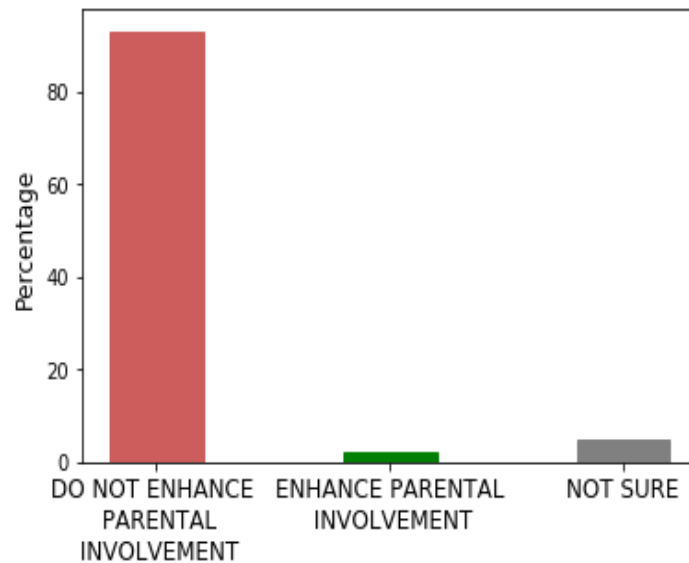


Figure 8: Enhancement of parental involvement

4.1.2 Views of Education Stakeholders on the Use of Digital Technology

To get views and perceptions of various education stakeholders on the potential use of digital technology such as a centralized Education Management Information System for improving parental involvement in monitoring and tracking students' academic progress. The researcher collected primary data from teachers, parents and education officers. After data analysis, 92.30 % of the respondents agreed that the application of digital technology like a centralized Education Management Information System can improve parental involvement. While 6.20 % of total responded disagree and 1.50% said their not sure whether centralized Education Management Information System can improve parental involvement for students' academic achievement. Figure 9 illustrates the findings of the data collected from teachers, parents, guardians, Districts Education Officer and Ward Education Officer.

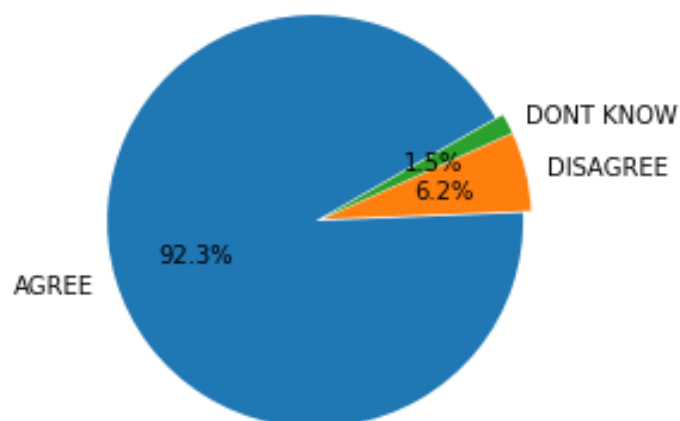


Figure 9: Application of digital technology for enhancing parental involvement

4.1.3 Reason on Why Tanzanian Secondary Schools Prefer to use Manual System

The study investigated why most secondary schools prefer to use the manual system rather than the available digital technology in administering school academic activities. The primary data was collected from teachers, district education officers, and Ward Education Officers to investigate on why most secondary schools do not prefer to use the digital technology for reporting students' academic progress and in administering school academic activities.

After the data analysis, 55.30 % of the respondents said the digital system leads to an increase in the costs of money in running the school's academic activities. While 23.70 % of the respondents said schools lack ICT infrastructure for supporting the implementation of the digital Education Management Information System, and 21.00 % of the respondents said it due to the computer illiteracy of teachers. Figure 10 illustrates the findings of the data collected from teachers, Districts Education Officers, and Ward Education Officers.

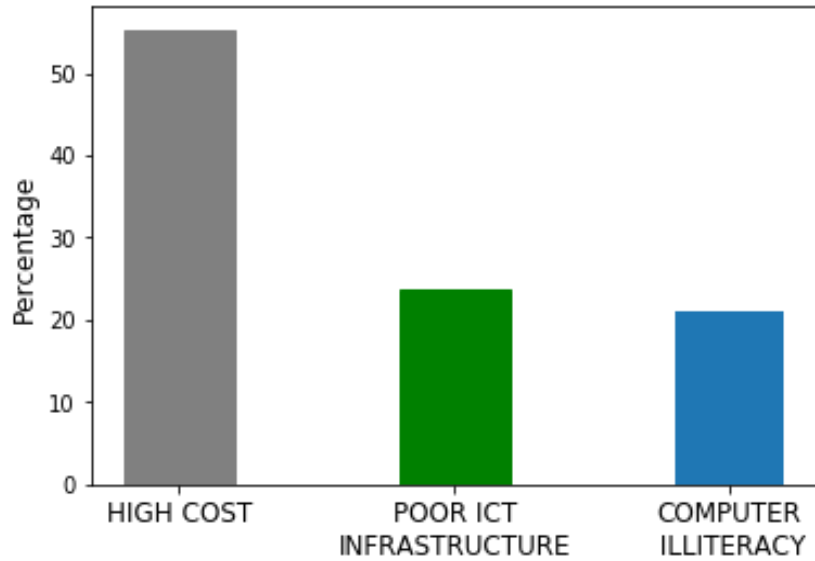


Figure 10: Factors that contributes to the use of the manual system

4.2 Assessment of Parental Involvement Concerning Gender

The study used demographic information to assess parental involvement of male and female in monitoring and tracking students' academic progress. From the data analysis, the study found that parental involvement of females in monitoring and tracking students' academic progress is 56.60% while parental involvement of males is 43.40%. Figure 11 presents the findings of primary data collected from one hundred and eight respondents.

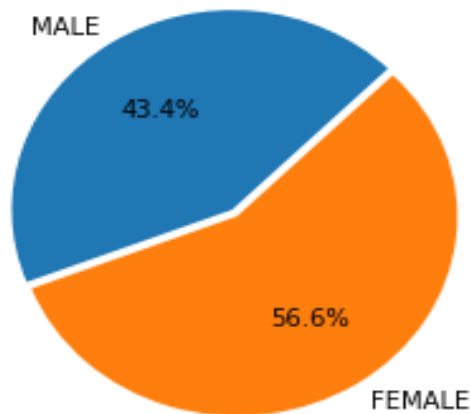


Figure 11: Comparison of parental involvement with gender

4.3 Evaluation of ICT Infrastructures in Secondary Schools

The study evaluated ICT infrastructures in secondary schools to determine whether they can support the implementation of centralized Education Management Information. In this respect, teachers were asked if their secondary schools have a computer laboratory for teaching or computer in offices for other academic uses.

After the data analysis, the study found that 88.4 % of the respondents said their secondary schools have a computer laboratory for teaching, learning, and computers in offices for other academic uses. While 11.6 % of the respondents said their secondary schools do not have a computer laboratory for teaching, learning but they have computers in offices for other academic uses and no secondary school which does not have any computer at all. Figure 12 illustrates the findings from data analysis.

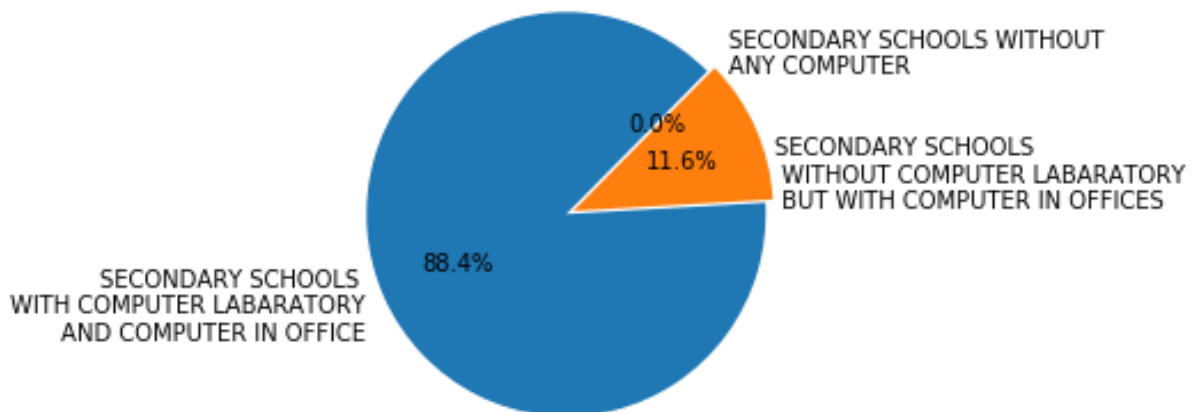


Figure 12: Analysis of ICT infrastructure in secondary schools

4.4 Discussion

This study was conducted to answer three research questions which were originated from the research objectives: The following are the research questions addressed by this study:

- i. To identify and analyze an existing system used by secondary schools for enhancing parental involvement in tracking student's academic in secondary schools and collect requirements of the proposed system.
- ii. To develop and implement an education management information system for enhancing parental involvement in tracking student's academics in secondary schools.
- iii. To validate the education management information system for enhancing parental involvement in tracking student's academic in secondary schools.

4.4.1 Strength and Weakness of an Existing System

To investigate drawbacks of an existing system used by secondary schools for administering school academic activities, this study identified and analyzed the strength and weakness of an existing system and findings revealed that the existing system used for administering school academic activities contributes to poor delivery of quality education due to ineffective collection and dissemination of education information for education officers, disclose of student report, loss of data integrity associated with manual system of reporting students' academic reports, ineffective communication between parents and teachers and poor parental involvement in monitoring and tracking students' academic progress due to social and economic activities.

A high number of students enrolled in secondary schools consume the time of teachers during the preparation of students' academic reports. Moreover, the system does not enhance frequent monitoring and tracking of students' academic progress simply because the system parents used to wait up to the end of the terminal or annual examination to get student's reports. Furthermore, parents have to visit the school physically to collect students' academic reports. However, due to social and economic activities, most parents fail to involve the schools' academic activities and in monitoring and tracking students' academic progress.

4.4.2 A Framework for Implementing EMIS in Tanzanian Secondary Schools

The study investigated a cost-effective framework for implementing an Education Management Information System in Tanzanian secondary schools. In this respect, the study evaluated the available ICT infrastructure in secondary schools to determine whether they can support the implementation of EMIS. Findings from the study revealed that ICT infrastructure in secondary schools can potentially support the implementation of the EMIS for monitoring and tracking students' academic progress.

However, due to budget constraints, most secondary schools will not afford to buy a powerful Server machine for installing EMIS. In that respect, the study proposed Software as a service to be a model of implementing the EMIS in secondary schools. With the use of SaaS, the model does not require the school to own a powerful server machine, public IP address and IT professional system administrator for managing the system. The school can enjoy the use of digital technology by paying the services based on the subscription of their usage.

4.4.3 Implementation of EMIS for Enhancing Parental Involvement

This study was designed based on existing knowledge, theories and concepts and findings of parental involvement for students' academic achievement of past scholars. Various studies significantly support the potential use of digital technology to enhance communication between teachers and parents for students' academic matters (Chena, 2015). To answer research questions of the third objective, the study investigated drawbacks of manual system and collected requirements which have to be integrating into the EMIS to effectively enhance parental involvement in monitoring and tracking students' academic progress using E-mail and SMS.

4.5 Enhancing Parental Involvement for Student's Academic Achievement

To address the challenges of the manual system, the study implemented a centralized Education Management Information System for monitoring and tracking students' academic progress in secondary schools, of the Arusha region. The system will address problems encountered by the manual systems and improve the collection and dissemination of accurate and timely academic information. The implemented system adopted Software as Service cloud computing services to allow a school to get services without having a powerful Server

machine, to pay for the public IP address and to employ a professional IT system administrator.

4.5.1 Benefit of Centralized Education Management Information System

To address challenges of delay of IT technical support, the study proposed a system to be hosted centrally to ensure one point of administration and to deliver a high dedicated IT desktop support services in secondary schools. The EMIS requires schools to have a domain name and internet connection to utilize the services of the digital system.

4.5.2 Conceptual Framework of the System

This study proposed a cost-effective Framework of the Education Management Information System required to enhance efficiency collection and dissemination of education management information in secondary schools. The system architecture uses SaaS to simplify and reduce the total cost of ownership in secondary schools. The system will be centrally hosted and managed at a single point of administration whereby there will be no need for schools to have a budget of buying a powerful Server machine for installing the EMIS and no need for having annual payment of the public IP address. All secondary schools will be given a domain name indicating the name of the school, for connecting to the server machine installed with the education management information system. A good example of the domain name will be <https://www.emis@nambalasec.ac.tz>.

Due to the sensitivity of educational data, the education management information system will be protected from hackers using the SQL injection mechanism. Moreover, at the access level, only system administrators will be able to view some modules containing sensitive educational information. Other users will be granted access to the system and required to login to the system by supplying password and user name for authentication. Once the user forgets the password, they can supply their e-mail address to recover their password. Furthermore, the EMIS require users to change the password for various security reasons. The School Academic Teacher will be given the administrative role of controlling and managing the system at the school level. Parents and guardians will get connected to the system and they can log in to monitor the academic progress of the students and to view the school calendar to get aware of the school academic activities and events. Further, the system will be sending reports to the parents notifying them through E-mail and SMS for the

academic progress of their students. Figure 13 describes the conceptual framework of the system.

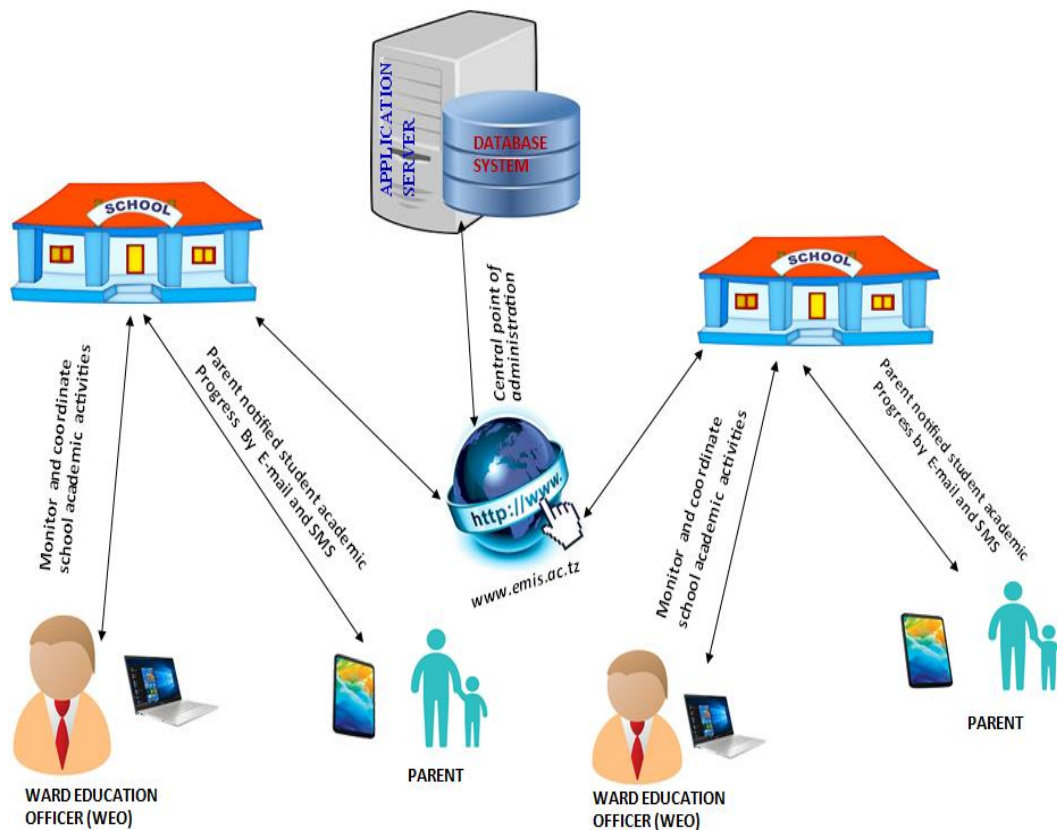


Figure 13: Conceptual framework of the centralized education system

4.5.3 Software as a Service

This study used Software as a Service Cloud computing system architecture to implement a cost-effective solution for enhancing parental involvement in monitoring and tracking students' academic progress in secondary schools. The system is expected to enhance the accuracy and timely dissemination of education information in Tanzanian secondary schools. Software as a Service is a licensing model whereby the application software is hosted at a central point of administration and the model of delivering services is accessed online on a subscription basis (Wiley, 2018). The architecture is cost-effective for secondary schools simply because it requires only costs related to training, maintenance, and technical support.

4.6 Description of the System

The centralized Education Management Information System was developed and implemented based on the requirement specifications of running school academic activities. However, the

main objective of the system was to automate the process of administering school academic activities by implementing a system of enhancing poor parental involvement in monitoring tracking students' academic progress using E-mail and Short Message Services. To achieve the goal, the system was designed in such a way that, teachers can upload students' marks which include tests and final examination, attendance and academic discipline of the students.

Moreover, the system sends a notification message to the parents by E-mail and Short Message Services informing them about the ongoing academic progress of the student at school. However, parents can log in to the system to track and print the student report. Whenever a student misses a class five times consecutively or the score marks in test examination is below thirty, the system can automatically notify parents by e-mail and SMS. Table 5 shows a list of users with their daily tasks that can perform in the system.

Table 5: List of users of the system and their assigned tasks

S/N	Users	Assigned task
1	School Academic Teacher	Responsible for administering school academic activities. The academic teacher can add users, subject, assign subject to teachers, and notify parents by sending E-mail and SMS about students' academic progress.
2	Class teacher	The class teacher has to upload students' discipline
3	Subject teacher	The subject teacher can upload students results
4	Discipline teacher	The school discipline teacher can upload student behavior into the system
5	Ward Education Officer	Responsible for monitoring school academic activities by viewing student's results and academic activities
6	Parent	Parents can log in, view and print student results
7	Students	Students can log in, view, and print academic results

4.6.1 User Access Control

In the context of information system security, the term user access control is used to mean a process of protecting user authorization. This study designed a system by enforcing the security mechanism of regulating access to its users. However, the system has five users who

are school academic teacher, teacher, student, parents, and Ward Education Officer. Every user has to login to the system by supplying password and username and are required to change the password at a forts login for security reasons. After successfully login, the user of the system will be granted with a system dashboard contains menu showing action for performing different tasks related to their assigned responsibilities.

The system has three access control mechanisms for the users of the system who are the system administrators, school academic teachers, and normal users. The system administrator whose responsibility is to manage and control all security aspects of the system has read, write and execute access control. The administrator can perform technical duties remotely. The second user is school academic teachers who have read and write access control. The school academic teacher can audit security aspects of the system such as user logs and activity logs and can be delegated with administrative power by the system administrator to perform the administrative role at the school level once the need arises. Normal users have only read-only access control. The remaining users who are students, parents and Ward Education Officers also have read-only access control. Table 6 contains user access control of the system.

Table 6: User’s access control

S/N	Users	Access control
1	System Administrator	Read, Write, Execute (R, W, X)
2	School Academic Teacher	Read, Write, ___ (R ,__W,___)
3	Teacher	Read, Write, ___ (R ,__W,___)
4	Parents and Guardian	Read, ____, ___ (R ____,___)
5	Student	Read, ____, ___ (R ____,___)
6	Ward Education Officer	Read, ____, ___ (R ____,___)

4.6.2 Authentication of the System

For security purposes, the centralized Education Management Information System requires users to supply correct usernames and passwords for system authentication. When a user forgets the password, the system allows the user to reset the new password by clicking the button of the forget password and to follow instructions to reset the new password.

Moreover, users can change the password for security purposes. The system is enforced by security aspects of system confidentiality, data integrity, nonrepudiation, and system availability to enforce the security of data. Figure 14 shows the system interface of the centralized Education Management Information System.

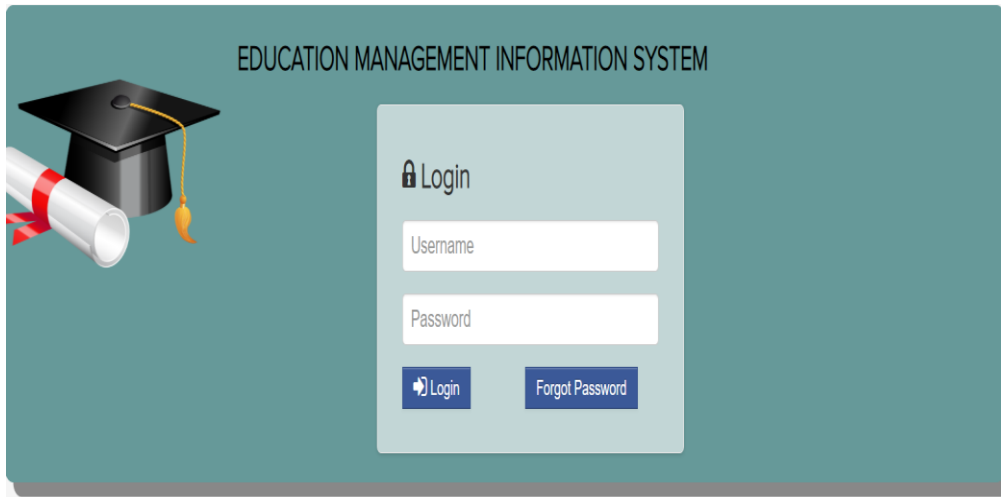


Figure 14: User login interface of the system

4.6.3 System Interface of the School Academic Teacher

The school academic teacher can add users to the system, add subjects, add class, and assign subjects to the teacher. Under the communication panel shown in the dashboard, the school academic teachers can choose to send E-mail or SMS to the parents notifying them about the academic progress of their students. The dashboard below shows administrative tasks that can be performed by the school academic teacher. Figure 15 shows an interface of the system which are used the school academic teacher to perform different academic tasks.

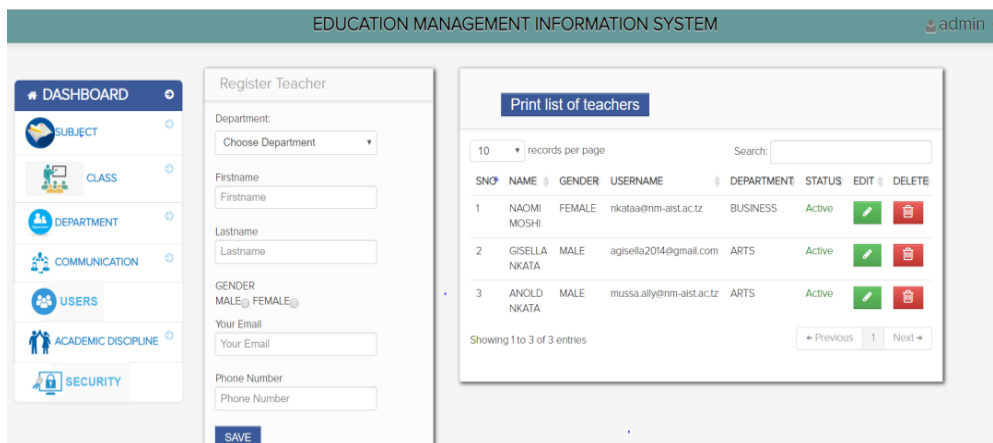


Figure 15: System administrator adding teachers into the system

After the school academic teacher has added the teacher into the system, all teachers will be assigned subject to teach. The subject teacher will be able to upload students' marks and class attendance. This feature will improve the productivity of teachers compared to the manual system. Figure 16 shows the system interface whereby school academic teacher is assigning subjects to the teachers.

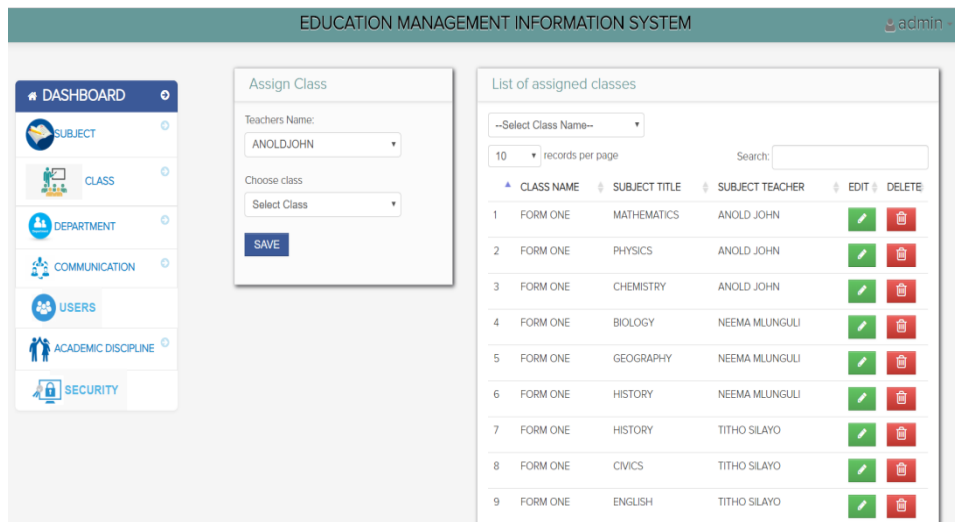


Figure 16: School academic teacher assigning subject to teachers

4.6.4 System Interface of Teachers

The centralized Education Management Information System required for collecting, storing and disseminating education information contains system modules that enable teachers to upload marks of their students, class attendance and to record student behavior. The EMIS allows the teacher to view, edit, print and notify parents about the academic progress of the student by sending E-mail and SMS.

After marks have successfully uploaded by the subject teacher, the system can track all students who scored “F” in a particular subject for example **MATHEMATICS** to automatically notify parents by sending E-mail and SMS stating that “**YOUR STUDENT SCORED F IN MATHEMATICS**”. Figure 17 shows the menu action whereby the subject teacher can upload marks scored by the students.

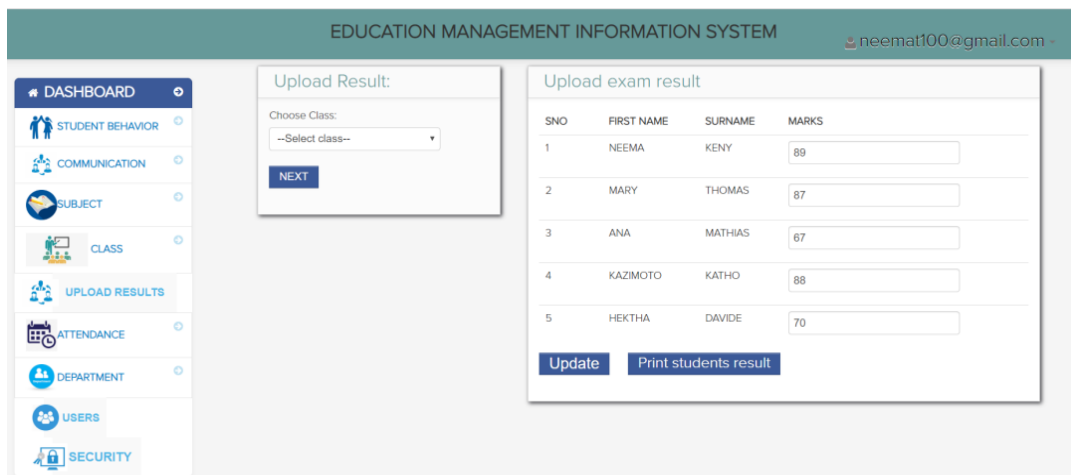


Figure 17: Teacher uploading marks

To reduce the number of student dropouts and improve the performance of students' in national examination results, the education management information system has designed in such a way that parents can monitor and tracking student's class attendance by login to the system at any time. This system can save time and reduce costs associated with the paperwork which were used for collecting and processing students' class attendance.

4.6.5 System Interface of Parents

The parent can use the EMIS to view and print students' academic reports. To enhance parental involvement in monitoring and tracking students' academic progress, parents can monitor student attendance, behavior and see marks scored by students in test and final examination through login into the system rather than going to school physically. Figure 18 shows parents monitoring class attendance of the students in mathematics subjects.

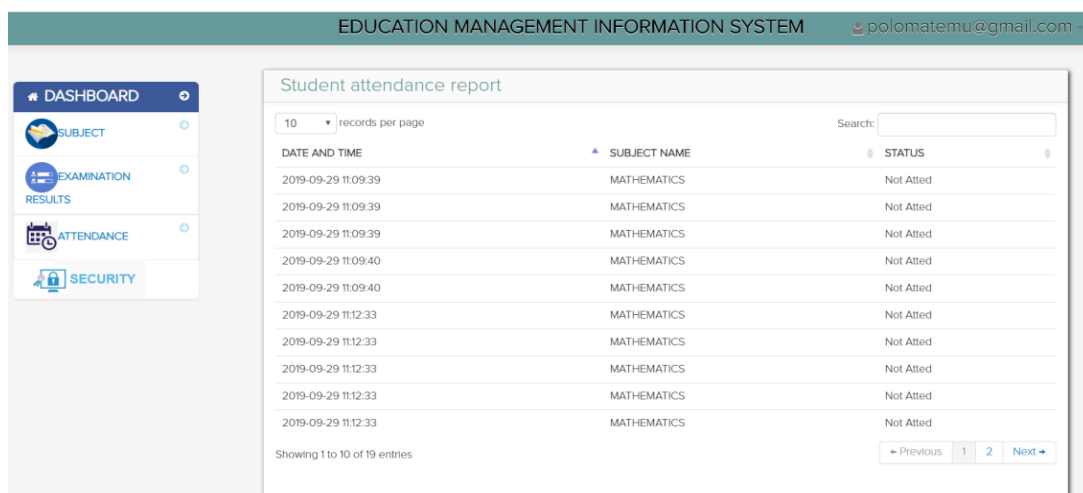


Figure 18: Parent monitoring class attendance of the student

Moreover, parents can get notification messages by E-mail or SMS send by school academic teachers or class teachers at any time whenever needs arise. Furthermore, parents can easily be involved with the school's academic activities by visiting the school calendar contained in the system. Figure 19 shows the system interface of the parents' notification using SMS.

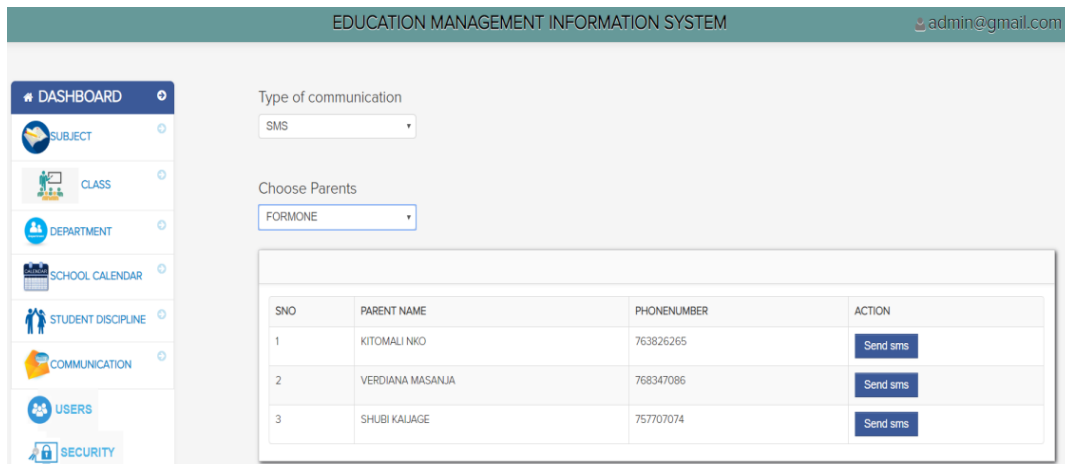


Figure 19: Parent notification using SMS

4.6.6 System Interface of the Students

The centralized system allows students to log in and views academic reports which include class attendance and marks for the examination. Also, the student can view school academic events contained in the school calendar. Figure 20 shows the system interface of the student.

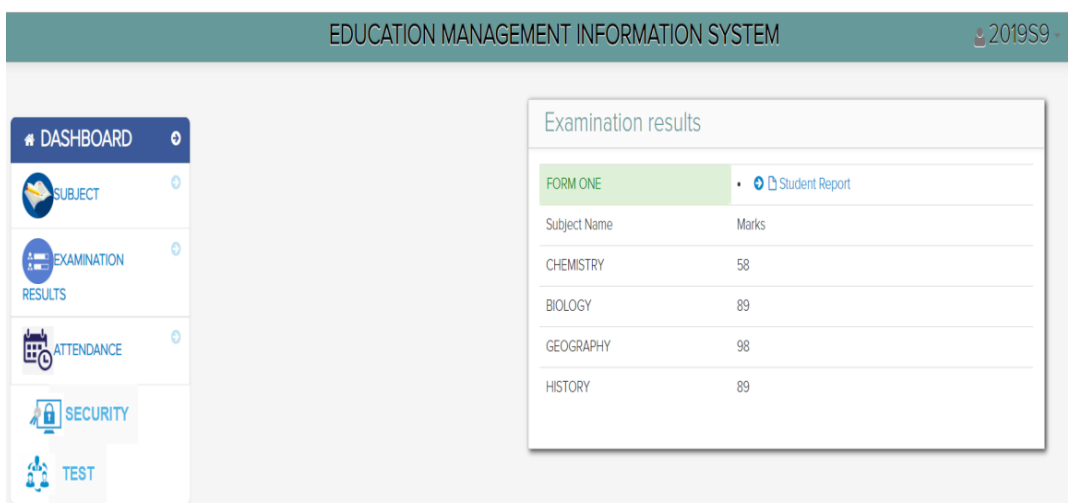


Figure 20: Student monitoring examination results

4.6.7 System Interface of the Ward Education Officers

The Ward Education Officer whose responsibility is to monitor and coordinate the academic activities of schools that belong to his/her assigned ward. The system has integrated with the modules which enable WEO to monitor and track school academic progress by just login into the school system. Once after login into the system, WEO can see school events that are scheduled into the school academic calendar, list of teachers and students. This feature of the system can potentially facilitate the activities of WEO in planning, monitoring, controlling and relocation of school academic resources. Figure 21 shows the system interface of the Ward Education Officer showing school events scheduled in the school calendar.

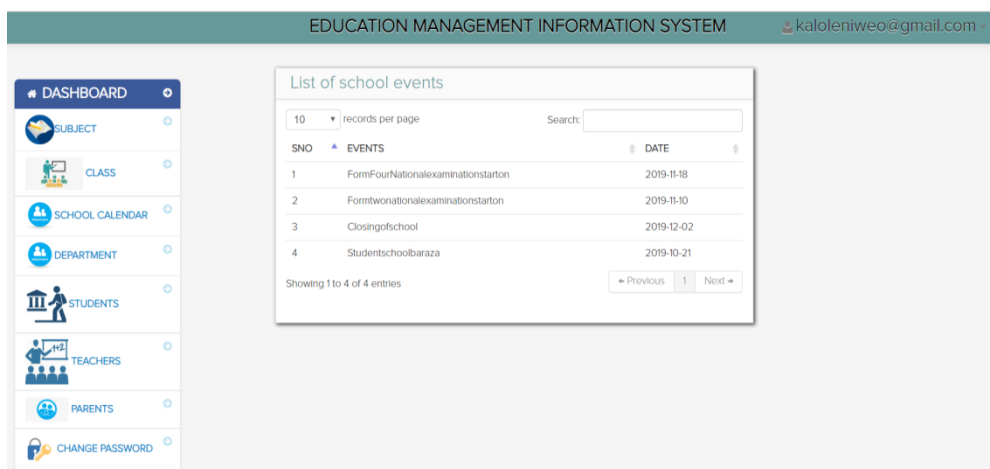


Figure 21: Ward Education Officer monitoring school events

4.7 System Validation

System validation is a dynamic practice of conforming system functionality by ensuring that the developed system contains the quality that addresses the needs of users (Mustaquim & Nyström, 2015). The exercise involves an action of checking system functionalities concerning operational activities and requirements specification of the system. This study conducted system validation to test functional and non-functional requirements of the EMIS such as system usability and system security. To deliver a high-quality system with customer satisfaction, the study used dummy data and real data in performing Alpha and Beta system testing respectively.

4.7.1 Alpha System Testing

Alpha system testing is usually conducted with the developer to make sure that the system operates properly before it is implemented for operation (Kendall, 2012). This study used dummy data when performing unit testing, integration testing, and system testing before acceptance testing. In software engineering, usually Alpha system testing use dummy data to test the functionality of the system module specification (Wasson, 2006).

4.7.2 Beta System Testing

Beta system testing is conducted in the presence of users to validate system acceptance (Stellman, 2006). This study conducted acceptance testing by using real data into two different secondary schools in the Arusha region. In software engineering Beta system testing usually use real data to test the functionality of the system (Wasson, 2006).

4.7.3 Selection of Secondary Schools for System Validation

To address a research question of the third objective, the study conducted system validation in the presence of eight teachers of Osiligi secondary schools and ten teachers of St. Monica secondary school. The Osiligi secondary school is located at the Arusha district council while St. Monica secondary school is located at Meru district council. These secondary schools were selected based on demographic information such as geographical location, ICT infrastructure and computer literacy of teachers. During system validation, school academic teachers, computer teachers, and other subject teachers all attended user acceptance testing.

4.8 Phases of System Testing

In software engineering, system validation involves four phases which are unit testing, integration testing, system testing and user acceptance testing (Mustaquim & Nyström, 2015). Unit testing and integration testing are called white box testing. This is because the exercise requires a developer to have a strong knowledge of the internal operation of the system (Stevens, 2006). System testing and user acceptance testing are also called black-box testing and white box testing. This is because the exercise requires a strong knowledge of two different experts; first, it requires knowledge of developer who knows the internal operation of the system, secondly, knowledge of users who knows exactly on how the institution operates (Stevens, 2006).

To address the problem of poor parental involvement for students’ academic achievement, the study conducted system validation with an experienced school academic teacher, school discipline teacher and subject teacher who knows how a school operates. Moreover, the validation was conducted by a researcher who developed the EMIS for enhancing parental involvement in monitoring and tracking students’ academic progress and knows the internal operation of secondary schools. Figure 22 illustrates the phases used by this study to perform.

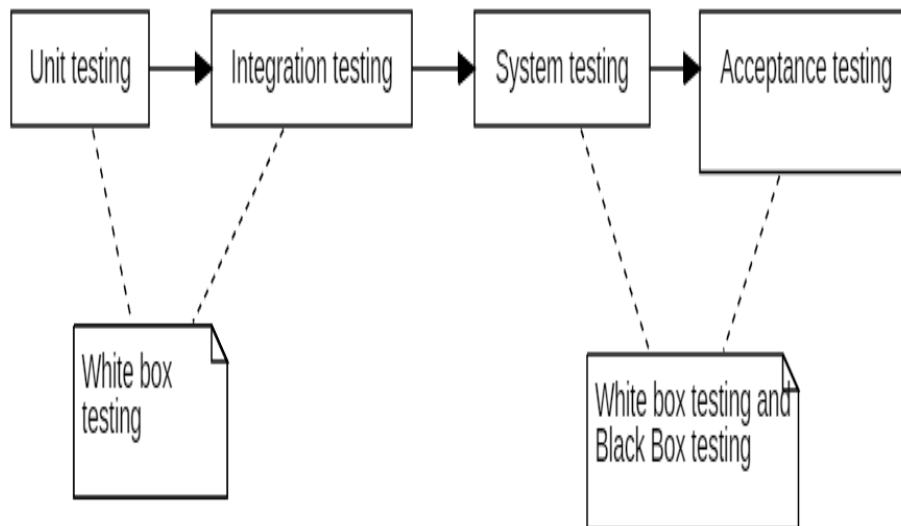


Figure 22: Phases used for system validation

4.8.1 Unit Testing

Unit testing is the process of testing each unit of code to fix system bugs in a source code (Kendall, 2012). This study performed unit testing during the development process to ensure every single code runs with an error-free. During unit testing, dummy data were used to test system functionalities of the independent module to remove and fixed system bugs.

4.8.2 Integration Testing

Integration testing is the process of validating functionalities of the combined modules (Stevens, 2006). The study conducted integration testing to verify the functional requirements of the system, system performance, and system reliability. The dependable system modules were combined and tested to verify their functionality. Table 7 shows a list of modules used to perform integration testing.

Table 7: Modules performed with integration testing

S/N	Module	Status	Remarks
1	Login module	Tested	Accepted
2	Module for adding subject, users and assign teachers subject for teaching	Tested	Accepted
3	Security module which includes system log and activity log	Tested	Accepted
4	Module for uploading marks, attendance, and student behavior	Tested	Accepted
5	Module for shifting class	Tested	Accepted
6	Module for generating an alert message to parents and student for the critical failure of the student	Tested	Accepted
7	Module for sending E-mail and Short Message Services	Tested	Accepted

4.8.3 System Testing

The study used functional and non-functional requirements collected from secondary schools and education officers to perform system testing. To address challenges of the manual system used by secondary schools for administering school academic activities, the study invited an experienced school academic teacher, school discipline teacher, and subject teacher to attend the exercise of system validation.

To achieve the objective, teachers were created with an account for login and to perform school academic activities which includes uploading marks, attendance of the students and for notifying parents' academic progress of their student by sending E-mail and Short Messaging Services. Figure 23 below contains the functional and non-functional requirements used for system testing.

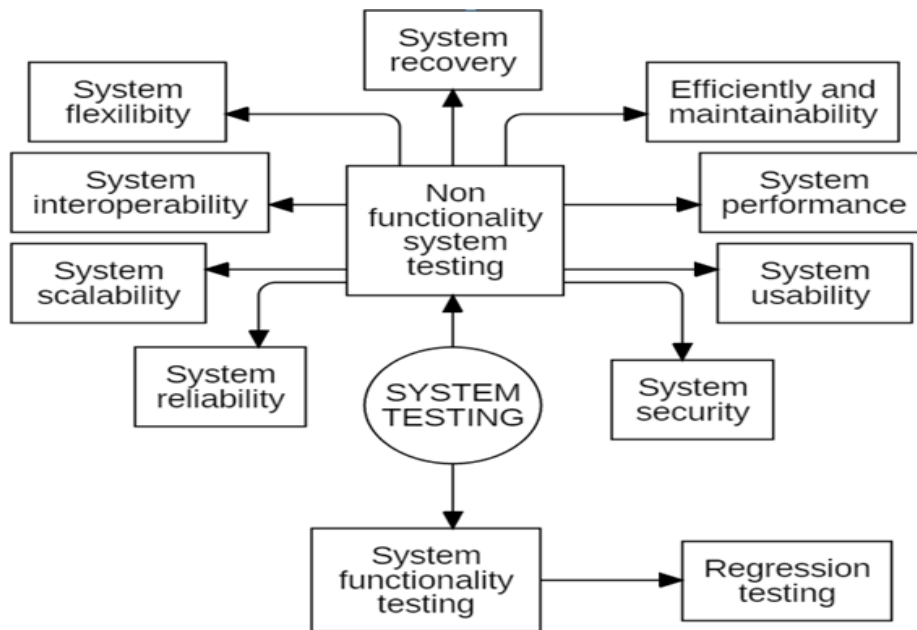


Figure 23: Functional and non-functional requirements performed with system testing

4.8.4 Users Acceptance Testing

In software engineering, user acceptance testing is done by a group of clients to validate the acceptability of the system based on business processes (Wasson, 2006). It is a final stage of validating scientific contributions made by the study in solving the problem which was studied. This study performed user acceptance testing to two different secondary school teachers to measure the degree of acceptance of the digital technology of enhancing parental involvement for students' academic achievement. During user acceptance testing, teachers were created with an account for login and perform their tasks related to school academic activities. The study evaluated functional requirements and non-functional requirements of the EMIS by performing user acceptance testing. Table 8 contains functional requirements validated for user acceptance testing.

Table 8: List of functional requirements performed with system validation

S/N	Users	Description of the action	Remarks
1	School Academic Teacher	To log in to the system and add users, a subject, assign subject to a teacher and Send E-mail and SMS to the Parents	Accepted
2	Teacher	To login to the system, upload, and print students results which include marks for the test, terminal, annual examination, and class attendance	Accepted
3	Student	To login and view academic results and class attendance	Accepted
4	Parent	To login and view student academic progress which includes the performance of each subject, class attendance, and student behavior	Accepted
5	Ward Education Officer	To login to the system and view school academic activity resources which include records of teachers, students, and subject	Accepted

4.8.5 Non-functional Requirements Performed with System Validation

To validate system security and other quality attributes of the centralized Education Management Information System for enhancing parental involvement, the study conducted system validation in the presence of eighteen teachers of two different secondary schools to confirm the non-functional requirements of the system. The technical reason which made to choose teachers for system validation is because they are regarded as the primary users of the system. Table 9 contains-functional requirements validated for user acceptance testing.

Table 9: List of non-functional requirements performed with system validation

S/N	Non-functional requirements	Description of the action	Status
1	System performance	Measurement of system response time and throughput with a given pool of data	Accepted
2	System usability	System to be accessible by its users under normal operation	Accepted
3	System availability	System to be available to authorized users under normal operation	Accepted
4	System reliability	System to operate without failure upon a given condition	Accepted
5	Efficient and maintainability	System to operate efficiently and to be maintained	Accepted
6	System recovery	Ability to recover data upon system failure and user to recover forgotten password	Accepted
7	System scalability	System to be scalable and to handle the volume of data	Accepted
8	System interoperability	System to operates properly once after integration with other systems module	Accepted
9	System Security	Systems to provide security measure against intruder such as recording user logs, audit trail of user activity logs, change the password and reset forgotten password	Accepted

Also, the study used a questionnaire to evaluate the level of user acceptance of the centralized educational management information system for tracking students' academic progress. In this respect, eighteen teachers who attended user acceptance testing were asked to provide their views if centralized Education Management Information System can provide a significant contribution to parental involvement for students' academic achievement. After data analysis, the study revealed that more teachers accepted the proposed and developed technology to be used in secondary schools for reporting students' academic progress and administering school academic activities.

Among eighteen teachers of two different secondary schools who attended system validation, seventeen respondents which are equal to 94.40 % of total respondents strongly accepted the system. One respondent equal to 5.60 % of total respondents did not accept. However, these respondents provided their views by saying that, implementing Education Management Information System for tracking students' academic progress is a good solution for enhancing parental involvement for students' academic achievement but it might be affected by demographic factors such as ethnicity and education level of parents. Figure 24 shows the results obtained from eighteen teachers who attended system validation.

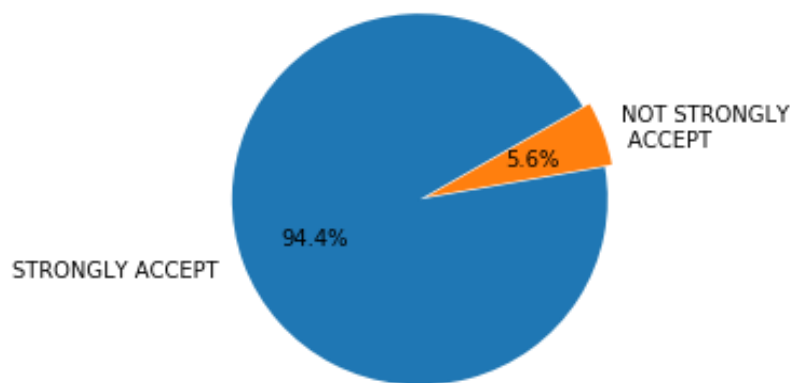


Figure 24: Results of the system validation

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main objective of this study was to improve the delivery of quality education and improve the academic performance of students' in Tanzanian secondary schools by enhancing parental involvement in monitoring and tracking students' academic progress using cost-effective digital technology. In this respect, the study used various scientific methodologies to investigate the impacts of existing systems used by Tanzanian secondary schools for administering school academic activities. Findings revealed that the existing system used by secondary schools contributes to many limitations of improving the delivery of quality education for sustainable development. Such limitations include poor parental involvement in monitoring and tracking students' academic progress, ineffective collection and dissemination of education information, loss of data integrity, poor data required to support planning, monitoring, and evaluation of the academic activities in secondary schools and formulation of education sound policies.

To strengthen the education management information system to effectively improve the quality of education in secondary schools, the study used three constraints of information system (IS) which are data, information and knowledge to develop and implement a centralized Education Management Information System for monitoring and tracking students' academic progress in Tanzanian secondary schools. The centralized system is going to address problems associated with poor parental involvement in monitoring and tracking students' academic progress, enhance the effective collection and timely dissemination of education information required to support the formulation of educational sound policies of delivering quality education for sustainable development and to reduce total costs of administering school academic activities which are caused with the usage of paper works in offices.

5.2 Recommendations

The practice of enhancing the delivery of quality education in Tanzanian secondary schools face various challenges which include lack of application of modern educational technology in teaching and learning, lack of documented national parental involvement policies of enhancing monitoring and tracking of students' academic progress. In this respect, the study recommends further study of strengthening the education management information system by investigating on how to integrate Learning Management System into a centralized education management information system in a cost-effective manner to improve teaching and learning practices and parental involvement for students' academic achievement.

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APPENDICES

Appendix 1: Introduction letter for data collection

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OUR Ref.No. NM-AIST/M.436/T.17/12

Date: 28th March, 2019

City Director,
Arusha City Council,
P.O. Box 3013,
Arusha.

Dear Sir/Madam,

RE: INTRODUCTION TO MR. ANOLD .S. NKATA

Kindly refer to the above heading.

I wish to introduce Mr. Anold S. Nkata with Registration No. NM-AIST/M.436/T.17, a Master's student at Nelson Mandela African Institution of Science and Technology in the School of Computational and Communication Science and Engineering.

As part of the requirement for Maste's degree, Mr. Nkata is undertaking a research with title "*Education Management System for Tracking Student's Academic Progress in Secondary Schools: A Case of Arusha region*".

In order to accomplish his research objectives, he would like to collect some information from your city/region especially in secondary schools. The information to be collected will be used for research purposes only and will help student to develop web-based Education Management System (EMS) for tracking student's academic progress for private secondary school as it states in the research objectives.

It is my sincere hope you will assist the student in accomplishing his study.

Looking forward for your cooperation.

Sincerely,


Shubi Kaijage, PhD
Ag. Dean

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Appendix 2: Questionnaire for teachers

Kindly respond to the questions below by putting a *tick* (✓) to the best answer and don't hesitate to provide a descriptive suggestion based on your opinions and experiences.

1. What kind of system does your school use to collect, store and disseminate school academic information?
 - a) Manual system
 - b) Web-based education information system
 - c) Both Manual system and Web-based education information system

2. List three challenges or shortcomings of using a manual system for administering school academic activities.
 - a)
 - b)
 - c)

3. Does the system used by your school for administering school academic activities enhance accurately, timely and reliable dissemination of school academic information?
 - a) YES
 - b) NO

4. Does the system used by your school to collect, store and disseminate school academic information enhance parental involvement for monitoring and tracking student's academic progress?
 - a) YES
 - b) NO

5. Does poor parental involvement affects the productivity of teachers and student's academic achievement.
 - a) YES
 - b) NO
 - c) I don't know

6. Do you think frequent monitoring and tracking of student's academic progress leads to student's academic achievement?

- a) YES
- b) NO

7. Does communication between teachers and parents for student's academic purposes lead to student's academic achievement?

- a) YES
- b) NO
- c) I don't know

8. Briefly, explain how does the manual system lead to poor parental involvement for monitoring and tracking student's academic progress?

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9. Does your school have an Education Management Information System (EMIS) or any other automated system such as Student Education Management Systems (SEMS) for administering school academic activities?

- a) YES
- b) NO

If YES, write the name of the systems?

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10. Explain how does the system has helped to improve parental involvement in monitoring and tracking student's academic progress of their students?

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11. Which system or tool does your school used to disseminate student's academic progress?

- a) Though letter from school given to students
- b) Through phone call
- c) Using office automated systems eg. MS excel office
- d) Using the Education Management System (EMS)

12. If the answer above is (a) or (b), what kind of challenges do you face when reporting student's academic report using either letter from school given to parents (paper-based system) or through a phone call?

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13. How often does your school provide student's academic report?

- a) Every week
- b) Every month
- c) Every term
- d) Others

If the answer is (d) Please specify.....

14. How long does it take to process student's academic reports for a class consists of more than thirty students using manual systems?

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15. Narrate the status of parents and guardians in visiting a school for the academic purposes of the students.

- a) GOOD
- b) BAD
- c) Not satisfactory
- d) Not satisfactory at all

16. How often do parents visit a school for the academic purposes of their students?

- a) Once per term
- b) Twice per term
- c) Less than five per year

17. Does a parent have enough time of visiting schools for the academic purposes of their student?

- a) YES
- b) NO

18. If the above answer is NO.

Explain why do you think some parents don't use their time in visiting schools for the academic purposes of their students?

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19. Do you think the use of education management systems (EMS) in secondary school can improve the academic performance of the students?

a) YES

b) NO

20. Provide your suggestions on how to improve the academic performance of the students in Tanzania's secondary school using ICT.

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21. Provide your suggestions on what should be done to increase parental involvement in monitoring and tracking student's academic progress using digital technology

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22. Narrate the level of computer literacy of teachers in Tanzania's secondary schools.

a) Very good

b) Good

c) Not good

d) Bad,they need training and capacity building

23. Does your school have a computer laboratory for teaching and learning or computer in offices for other academic uses?

a) YES,

b) NO,

c) The school does not have any computer for academic use

Appendix 3: Questionnaire for students (Written in kiswahili)

Changua jibu sahihi kwa kuandika herufi yake pembeni mwa swali au kutoa maelezo kwa ufasaha.

1. Toa maoni unadhani wazazi na walezi wa wanafunzi hupata taarifa za maendeleo ya wanao kwa wakati?
 - a) Ndio
 - b) Hapana

2. Je, ni njia gani wazazi hutumia kupata au kujua taarifa ya maendeleo ya kitaaluma ya mwanafunzi hasa akiwa shuleni kabla shule haijafungwa?
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3. Je mzazi au mlezi wako hufuatiliaga mara kwa mara shughuli za kitaaluma za shule ?
 - a) Ndio
 - b) Hapana

4. Katika masomo unayosoma shuleni kuna somo la Komputer?
 - a) Ndio
 - b) Hapana

5. Je, unajua kutumia computer, simu na mitandao ya Internet?
 - a) Ndio
 - b) Hapana

Appendix 4: Questionnaire for parents and guardians (Dodoso la wazazi)

Toa mchango wako wadhati kwa kujibu maswali yafuatayo ilikuchangia kuinua kiwango cha elimu cha ufaulu wa shuleza secondary Arusha.

1. Je, mfumo wa kuwajulisha wazazi maendeleo ya wanafunzi ni wa kidi gitali?
 - a) Ndio
 - b) Hapana

2. Je, hua unapata taarifa za nidhamu za mwanao akiwa shuleni kwa wakati?
 - a) Ndio
 - b) Hapana ni kwa kuchelewa

3. Kama jibu ni hapana, toa sababu kwa nini hua haupati kwawakati taarifa za mwanafunzi kila unapohitaji?

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4. Ni mara ngapi kwa mwaka hua unapata taarifa za kitaluma za mwanao?
 - a) Kilasiku
 - b) Kila wiki yamwezi
 - c) Kilamwezi
 - d) Vinginevyo.

Kama jibu la swali la hapo juu ni *vinginevyo* cha kipengele (e), toa maelezo kwa kina.

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5. Taja na eleza changamoto upatazo unapofuatilia maendeleo ya kitaaluma ya mwanao?

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6. Unapokuwa mbali na nyumbani kwa shughuli mbalimbali za kiuchimi, eleza ni njia gani hua unatumia kupata maendeleo ya kitaaluma ya mwanao ya shule?
 - a) Kupitia kwa mwanafunzi
 - b) Kupitia mtandao wa computer uliunganishwa na shughuli za kitaaluma za shule?
 - c) Vinginevyo.

Toa maelezo.....

7. Je unadhani ufuatiliaji wa mara kwa mara ya maendeleo ya shule ya kitaaluma ya mwanao unachanagia kuongeza kiwango cha ufaulu wa mwanafunzi katika masomo yake?
 - a) Ndio
 - b) Hapana

8. Ni mara ngapi hua unatembelea shule kwa ajili yakupata taarifa na maendeleo mbalimbali ya kitaaluma ya mwanao?
 - a) Mara moja kwa mhula
 - b) Mara mbili kwa mhula
 - c) Chini ya maratano kwa mwaka
 - d) Sina kumbukumbu nzuri

9. Taja vikwazo vinavyo kwamisha wazazi kufuatilia maendeleo ya kitaaluma ya mwanafunzi au mwanao akiwa shuleni.

10. Je unatumiaga simu katika shughuli zako za mawsiliano ya kila siku?
 - a) Ndio
 - b) Hapana

Appendix 5: Interview guide for Education Officers

Jibu maswali yafuatayo kwa kutoa maelezo ya dhati na kwa usahihi.

1. Mkoa wa Arusha una shule ngapi za secondary?
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2. Kati ya hizo shule za mkoa wa Arusha, ngapi ni shule binasifi na ngapi ni shule zinazo milikiwa na serikali?
 - a) Idadi ya shule binafsi
 - b) Idadi ya shule za serikali
3. Taja mipango dhubuti ya serikali ya kuboresha kiwango cha ufalu na ubora wa elimu katika shule za sekondari.
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4. Mfumo wa sasa unaotumiwa mashuleni kataika kuendesha shughuli za elimu unachangamoto gani katika zoezi la kuborsha mfumo wa utoaji wa elimu bora kwa maendeleo ya Taifa?
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5. Taja njia au mifumo inayokuwezasha wewe kama afsa elimu katika kupata habari kwa wakati na za usahihi za maendeleo ya kitaaluma ya wanafunzi mashuleni?
 - i.
 - ii.
 - iii.
 - iv.

Appendix 6: Questionnaire for system validation

Please choose the best answer and provide your brief explanation to the questions below to validate the functionality of the system for enhancing parental involvement for student's academic achievement.

1. Do you accept that the Education Management Information System can enhance parental involvement for monitoring and tracking student's academic progress?

a) Strongly accept

a) Not strongly accept

b) Do not accept complete

2. If your answer in question (1) above is (b) "Not strongly accept", please provide your suggestion about what should be done to address the problem of poor parental involvement in secondary schools?

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3. If your answer in question (1) above is (c) "Do not accept complete", please provide your suggestion on what kind of technology should be used to address the problem of poor parental involvement in secondary schools?

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