

INNOVATIVE FRAMEWORK FOR E-LEARNING SYSTEM IN EMERGING COUNTRIES

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Abstract

There are several adoption of ICT innovations into educational system especially in the area of information system applications that deals with record management in the educational institutes. Despite having various SDM in existence, there is no best SDM for implementing MIS and E-learning in educational institutes. This study aimed at designing an SDM framework for implementing MIS and E-learning integration in educational institutes. The objectives of the study is to carry analysis and examine the current MIS and E-learning platforms used in higher educational institutes in developing countries and to also identify a suitable SDM for implementing MIS and E-learning in higher educational institutes, to design models of MIS and E-learning for higher education system, to design models integrating big data and IoT into the framework for improving learning and teaching in educational institutions.

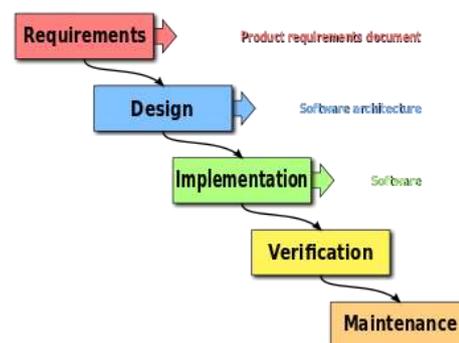
KEYWORDS: MIS E-learning, Agile, SDM, Modelling, IOT, Software, Framework, data

1. Introduction

1.1 Background of the Study

Software development methodology (SDM) is the procedures of overseeing software development task or exercises that fill in as a structure or model use by software engineers to deal with the procedures of building or development of software or data framework. SDM fill in as the procedure for creating and overseeing software applications.

Waterfall methods is a traditional and linear SDM that emphasizes on collecting software procedures and requirements as well as designing the architecture of the software before making the real development and testing^[1]. Waterfall is the earliest published software development method or procedure that was derived from detailed system engineering process with a particular principle of plan-driven procedure requiring planning and scheduling of whatever aspects or activities before commencing work on them^[2]. The model usually serves as a serial or progressive process that allow progress to be made in a downwards manner with list of stages or phases to be executed and completed one after another in order to develop a successful application or software project. That is, progressing to the next stage or level can be done only when the previous or preceding stage is done completely. In this case, each stage or phase of the model can continuously to be repeated until it is perfected or the desired result is obtained.



methodologies. Granger and Malaga ^[7] have conducted research on the applications of a framework for SDMs into information system curriculum in educational institutes. The British and

This research will therefore provide a framework to be adopted by software developers in developing and implementation of information system for educational institutes. The model will include integration of both big data and internet of things (IoT) technology for improving and enhancing learning process within educational institutes. This framework will also be helpful for graduate and post graduates institutes and it will work as a guideline for the e-learning teachers & students in the developing countries as well as in the whole world.

2. LITERATURE REVIEW

2.1 Software Development Methodologies

System development methodology (SDM) is referred to the framework that is used in structuring, planning and control the process of information system developing. Several frameworks have evolved over the years with their own weaknesses and strengths. The methodologies are not necessarily suitable for use by all projects, they are suitable for specific kinds of projects in accordance with technical, organizational, project and team consideration. Therefore, this research work has reviewed some major SDM which are presented below.

2.1.1 Agile Method

Agile method is meant to provide or accommodate change in the software requirements. It reduces the cost of development while providing a reasonable quality software. Agile model evolved in the 1990s when developers decided to break away the traditional structured, segmented, bureaucratic approaches to software development to moved towards more flexible development styles. The 'Agile' or 'Lightweight' methods as they were called were formally defined in a research paper by Edmonds in 1974. Some of the most prominent and popular agile methods of software development, that subsequently evolved, are 'Scrum' in 1995, 'Crystal Clear', 'Extreme Programming' in 1996, 'Adaptive Software Development', 'Dynamic Systems Development Method' in 1995 and 'Feature Driven Development'. In 2001, a group of pioneers in agile software development came together and declared the 'Agile Manifesto', which is a set of canonical rules of sorts, for agile software development methods” ^[8].

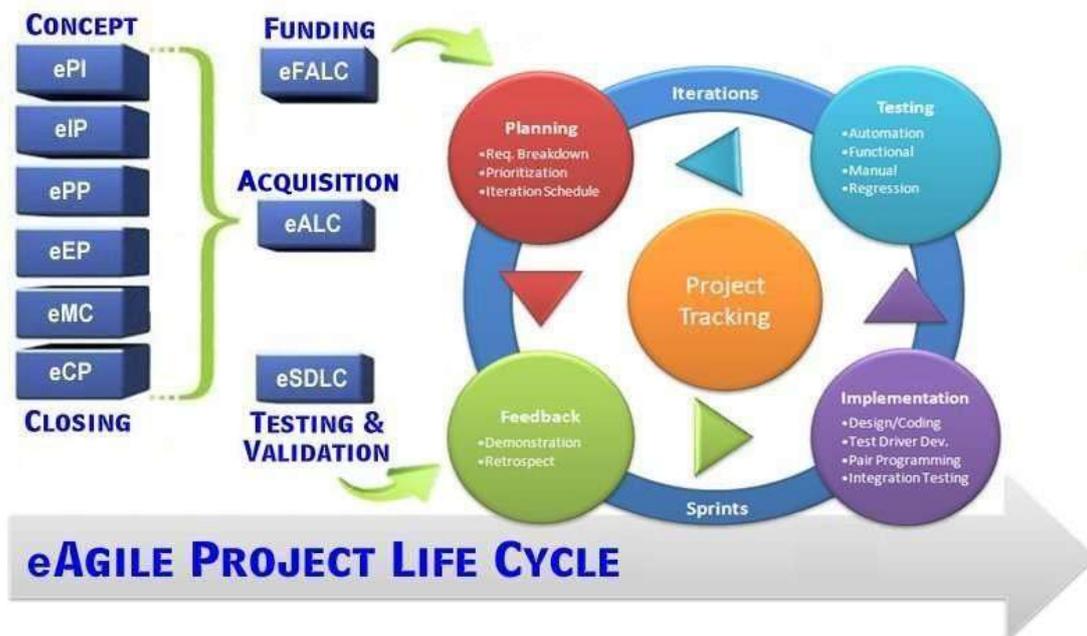


Figure 1: Agile SDM ^[8]

Agile development is based on the idea of incremental and iterative development in which the phases within a development life cycle are revisited over and over again

“Scrum is an agile development method which concentrates specifically on how to manage tasks within a team-based development environment. Basically, Scrum is derived from activity that occurs during a rugby match. Scrum believes in empowering the development team and advocates working in small teams (from 7 to 9 members)” ^[14].

Extreme Programming (XP) technique on the other hand is helping when there is frequent change on requirements or demands from the clients or when the clients are not sure about the functionality of this system. XP advocates frequent released of the product in “short development cycles”, which fundamentally improves the productivity of the system and also introduces a checkpoint where any client requirements can be easily implemented. The XP develops software keeping client in the target. The figure below shows how XP works ^[14].

Figure 3: Diagram showing XP ^[14]

Crystal Methodology on the other hand deals with three concepts of chartering, cyclic delivery, and wrap up. For chartering, various activities involved in this phase includes creating a development team, performing a preliminary feasibility analysis, developing an initial plan and fine-tuning the development methodology. In cyclic delivery, the main development phase consists of two or more delivery cycles, during which the team updates and refines the release plan, implements a subset of the requirements through one or more program test integrate iterations, integrated product is delivered to real users, and review of the project plan and adopted development methodology. The wrap up consists of activities as deployment into the user environment, post- deployment reviews, and reflections are being performed ^[14].

2.2 Concepts of eLearning and Learning Management System

E-Learning can be viewed as learning through electronic means. It involves acquisition of knowledge and skills using electronic technologies such as computer and internet ^[9]. With the introduction of internet, the university delivered courses materials, educational experiences as well as correspondences to students through emails. More technological advancements were made in 20th and 21st centuries to improve e-learning. These makes schools to deliver courses online and education is widely available and accessible to people regardless of their geographical and time constraints. Business organizations also adopted e-learning platforms to educate and train their employees.

2.2.1 Benefits of e-learning

The following are some of the identified benefit of e-learning ^[10]:

- i. Flexibility of timing and location
- ii. Improve student-to-student communication
- iii. Improve faculty-to-student communication
- iv. It gives room for different learning styles and methods
- v. Availability and accessibility of course materials
- vi. It reduces the faculty workload
- vii. It gives learners confidence and composure

2.2.2 Categories of e-learning

E-learning has two (2) categories that enable students to learn from the platform. The methods of obtaining information from e-learning platform depends on the learner's choice on the category to be used. Each of these categories has its own benefits and drawbacks. The two categories are Synchronous and Asynchronous e-learning.

Synchronous: e-learning is an instructor-led platform that provide real-time teaching or learning process instantly (online) to students. Both the learners and instructors or tutors must be present during the lesson period. The category uses real-time tool or media such as video conferencing and instant messaging or chat. This makes it possible for teachers and students to communicate and share knowledge or ideas with immediate response. The major benefit of synchronous e-learning is the absence of isolation from learners which makes them more social.

But this platform lack flexibility of time ^[11].

Asynchronous: e-learning is a self-placed learning process that can be done even offline with or without the presence of the teacher or students. Coursework and other learning communications are delivered through the web and email. Students can go through the web and download course materials as well as uploads any pending task. This platform has benefits of flexibility of time and schedules and also improve level of cognitive thinking of the students. The only shortcoming of this platform is that students feel like they are isolated working on their own ^[11].

2.2.3 E-learning and Educational Institutes

E-learning platform goes along with learning management system (LMS) which gives so many advantages that support face-to-face and online learning methods. The LMS has bring overall achievement in management of administrative training processes that facilitate and improve the traditional education or learning methods. LMS can save cost for organizations in terms of time and money through easy administration of large volume of data and information in a user-friendly manner by means of web-based environment

E-learning platforms provide overall control of administration, automation, communication with users, teachers and trainers, as well as course content management. They give efficient management of registrations and sign ups, creation of groups and courses. The roles of tutors, students, supervisors and administrators can all be managed on the LMS, and notifications, reminders and messages to users can be administered easily. It served as a powerful tool for creation and management of content and subjects in a simple and intuitive manner. Students can upload and



share content and work or projects with their teachers and fellow learners which in turn is stored in a database that can be accessible by all the stakeholders concerned.

The study proposed a real e-learning system with interactive learning forums that make it interesting to students to improve their knowledge level. The proposed platform will provide students with proper guidance in accordance with their faculties or universities. It also provides special lectures on specific topics provided by the subject expert for the benefits of the students. The proposed model will include a dedicated satellite responsible for distribution of learning contents and electronic materials to the connected institutions. The satellite is meant to relay through audio-visual medium and will employ multi-media multi-centric system in creating interactional classrooms ^[12]. The model is designed to improve the quality of education and interest of students in Gulf countries especially students of higher level. The students can get benefits from the system to develop their learning ability and to visualize the things.

The research suggest that learning methods should be adjusted to accommodate technology especially the use of e-learning platforms in educational institutes. The e-learning will change the level of thinking and learning of both students and teachers. It brings about interactive learning process whereby students use the learning forums to discuss with their colleagues as well as with the teachers regarding subject disciplines and other academic affairs. The platform will accord students with audio-visual learning contents in addition to reading methods ^[13].

3. METHODOLOGY

3.1 Research Design

The study is designed to combine survey and modelling approach. The survey create means of collecting raw data from the stake holders and respondents in educational institutes. The input and the data were analyzed and use for choosing appropriate software development methodology and prepare the SDM framework as well for the educational institute. The design of the models was achieved using UML techniques. The techniques depict the whole procedures in educational institutes that requires the use of MIS and E-Learning and gives clear indications for designing and implementing information system or E-Learning platform in educational systems.

The framework was designed bearing in mind the educational institutes of Nigeria and Pakistan, however, the framework is a worldwide framework that can be used across the globe or continents. Selecting the two domains is for accessibility of the researcher to the required data.

3.2 Survey Research Techniques

This section presents the procedures and techniques applied in the research for achieving the survey aspect of the study. It is presented in the following subsections

3.2.1 Population and Sample

Higher institutions of learning serve as the population of the study. However, twelve (12) institutes were selected from both Pakistan and Nigeria as the sample of the research. Six (6) institutions are selected from each of the country and comprises both federal and provincial universities, private universities and colleges/institutes. The sample was taken in accordance with the existence and availability of MIS and E-Learning integration within the selected samples. The raw data were used in simulating the models of the framework.

3.2.2 Data Collection

The study makes use of research schedules in collecting the raw data from the selected institutions. In each institute, enumerator is identified and picked and questions were prepared in a



structured manner in the form of questionnaires. The enumerators administered the questions to the stakeholders of the selected institutes and record whatever answers given on the research schedule and finally transmit the response to the researcher through post and mail.

3.2.3 Data Analysis

The collected data were analyzed according to the samples and were used for designing the model. However, the major response of the stakeholders is presented and analyzed using tables on the level of usage of the MIS and E-Learning as well as the processes involved in the selected samples.

3.3 Modelling Approach and Techniques

There are different modeling approaches in building software products. UML is the standard modeling language for software and system development^[17] and it is one of the modeling approaches and is a pictorial technique for demonstration and communication of ideas on systems by means of diagrams and supporting text. UML is powerful in describing the static and dynamic aspects of systems^[18] and it has specific diagrams known as modelling techniques^[16].

Algorithm and flowchart are used to present the stages of procedures for all the models presented in the models.

3.3.1 Swimlane

Swimlane is presented as pictorial regions or sections separated from adjacent or near Swimlane by vertical solid lines surrounding all the sides of the Swimlane with label at the top that contains element responsible for action states within the Swimlane.

Swimlane was used to describe the AIIMES model and the logic which derived the functions between the integrated modules that make up the systems. The model shows how entities in educational institutes interact with one another within the phases of the AIIMES.

3.3.2 Data flow Diagram

Data flow diagram (DFD) was designed to reveal or present the associations between various features or components of the MIS and E-Learning platforms. The DFD shows the interaction of the participants of these platforms in the educational institutes. This is particularly on the areas of integrating big data concepts and IoT concepts in improving and enhancing learning process in educational institutes.

3.3.3 Use Case Model

Use case presents description of the functional requirements in accordance with the users' views about the systems. For instance, security requirements or functions that allow users to log in or log out of the system, input data, process data, and generate reports, etc.^[16].

Use case diagrams was used in the research to show the various activities the stakeholders can perform in the framework. It makes the models to be consistent. It uses high level use case diagram and portray activities involving registration process, exam and results process, hostel and accommodation process, attendance and assessment process.

3.3.4 Activity Diagram



Activity diagram is a modelling technique that describes flow of activities as well as data flow. It is usually applicable in demonstrating business process workflow, movement within a use case, business rules logic, functional procedures and processes, and user interface (UI) screen flows ^[15]. Activity diagrams present models on the interactions of students as well as teachers or faculty members on the learning management system (LMS). It is also used to show models of interaction for stakeholders in assessment or exams.

3.4 Suitable Software Development Methodology for Implementing MIS and E-Learning in Higher Educational Institutes

This section presents a suitable software development methodology chosen by the researcher than can be used in adopting and implementing MIS and E-Learning in higher educational institutes. This include the type of methodology, phases involve during the adoption or implementation, actors involve in the system, elements attach to the actors and requirements needed for the implementation. These are presented in the tables 17, 18 and figure 1 below:

Table 17: Software Development Methodology for Implementing MIS and E-Learning in HEIs

SDM NAME	BENEFITS OF AIIMES	PHASES OF AIIMES
Agile Iterative and Incremental Methodology for Educational Systems (AIIMES)	<ul style="list-style-type: none"> -Accommodate change in software requirements -Reduces cost of development -It's characterized with many incremental releases -Team members and actors participate in all aspects of the software project -It involves multiple iterative and incremental development schedules to improve output -It provides demonstration at each design of the iteration to actors and take their feedback to next iterative and increment 	<ul style="list-style-type: none"> -Analysis -Planning and Designing -Implementation -Testing

Table 18: Actors, Elements, Process and Requirements involve in AIIMES

ACTORS	ELEMENTS	PROCESS	REQUIREMENTS
<ul style="list-style-type: none"> -Students -Academic/Faculty Members -Admin/Non-Academic Members -Management and Governing Boards -External Regulatory Bodies and Policy Makers -External Communities 	Activities involve or related to each actor	Actions required at each activity by the users	Functional and System requirements related to identification of actors, element specification, and process Assignment

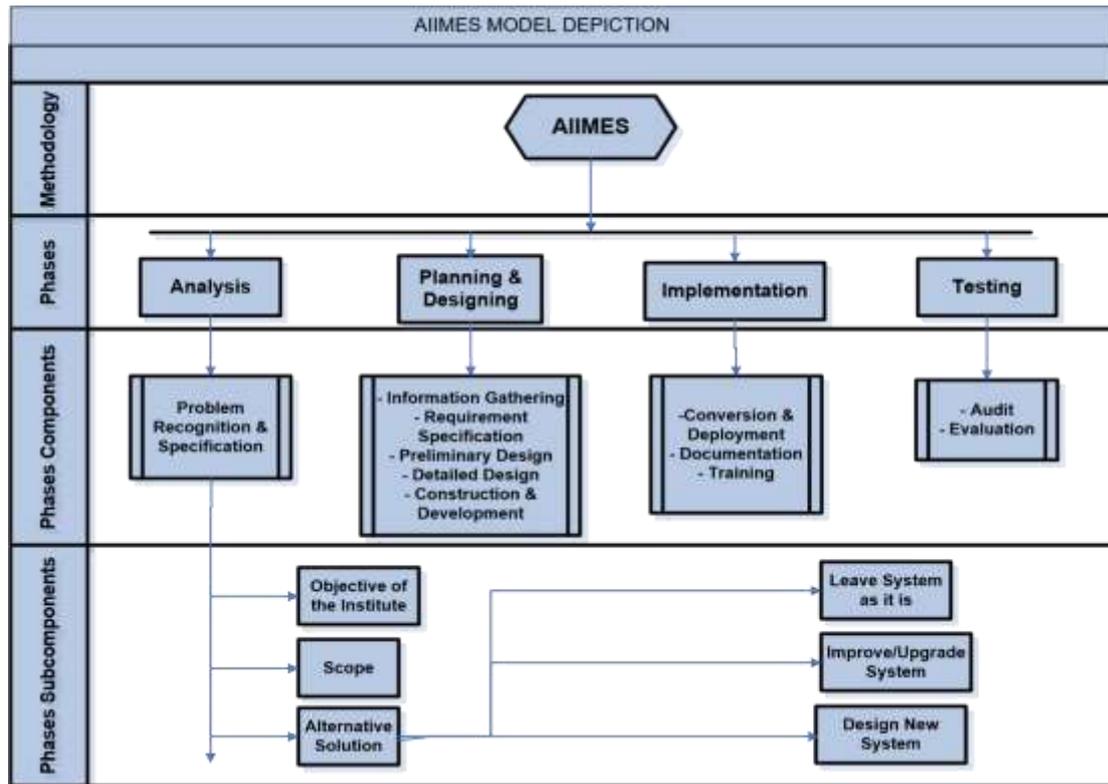


Figure 8: AIIMES Model Depiction

3.5 Models Integration of Big Data into the Framework for Enhancing Teaching and Learning in Educational Institutes

This section presents model for integrating big data into the framework for enhancing teaching and learning in higher educational institutes. The models are presented in the figures below:

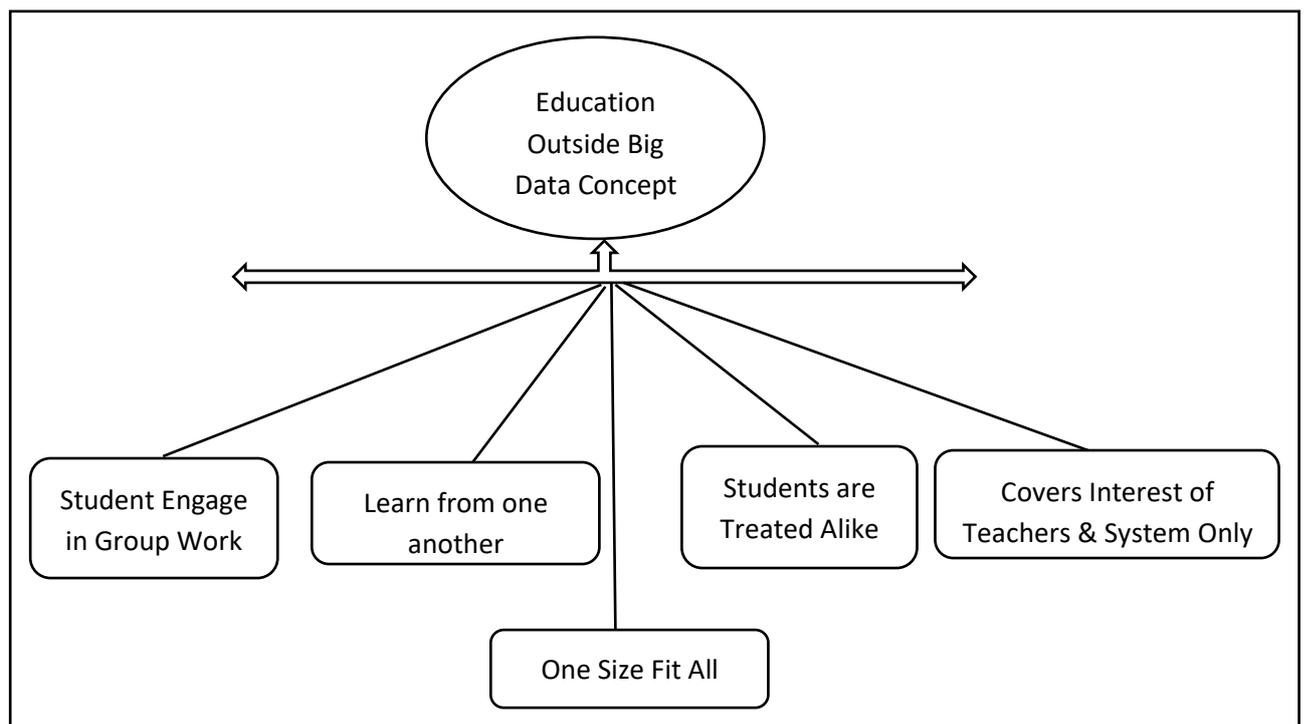


Figure 17: Model of Education System outside Big Data Concept

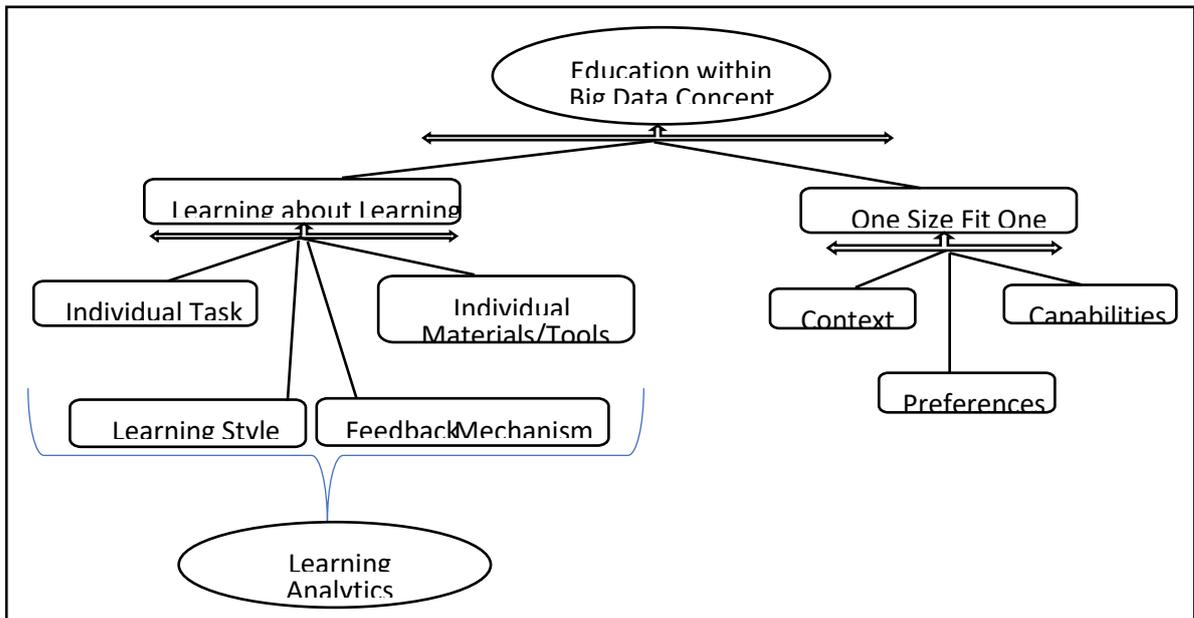


Figure 18: Model of Education System within Big Data Concept

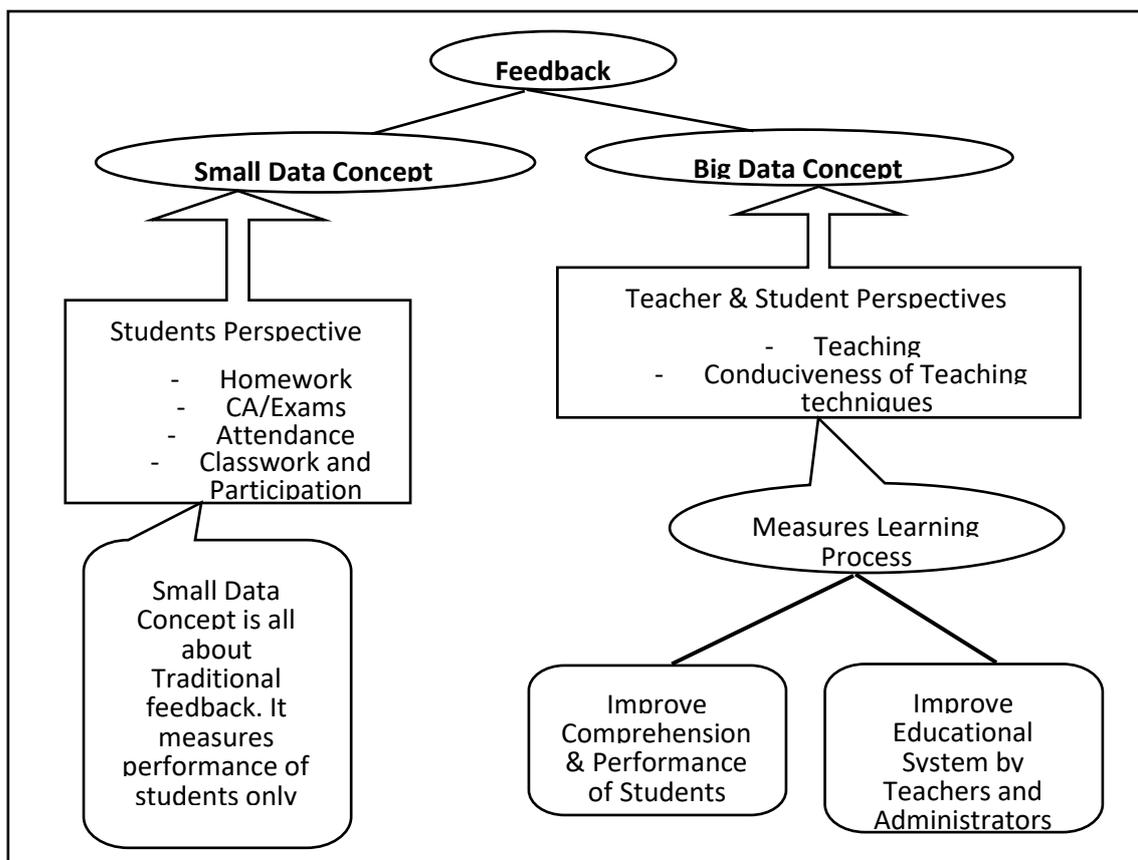


Figure 19: Model of Education System Presenting Feedback System of both Small Data and Big Data Concepts

3.6 Models integration of internet of things (IoT) into the Framework for Enhancing Teaching and Learning in Educational Institutes

This section presents model for integrating internet of things (IoT) into the framework for enhancing teaching and learning in educational institutes. This will provide means for the adoption of IoT into higher educational institutes in developing countries. The model is presented in the figures below:

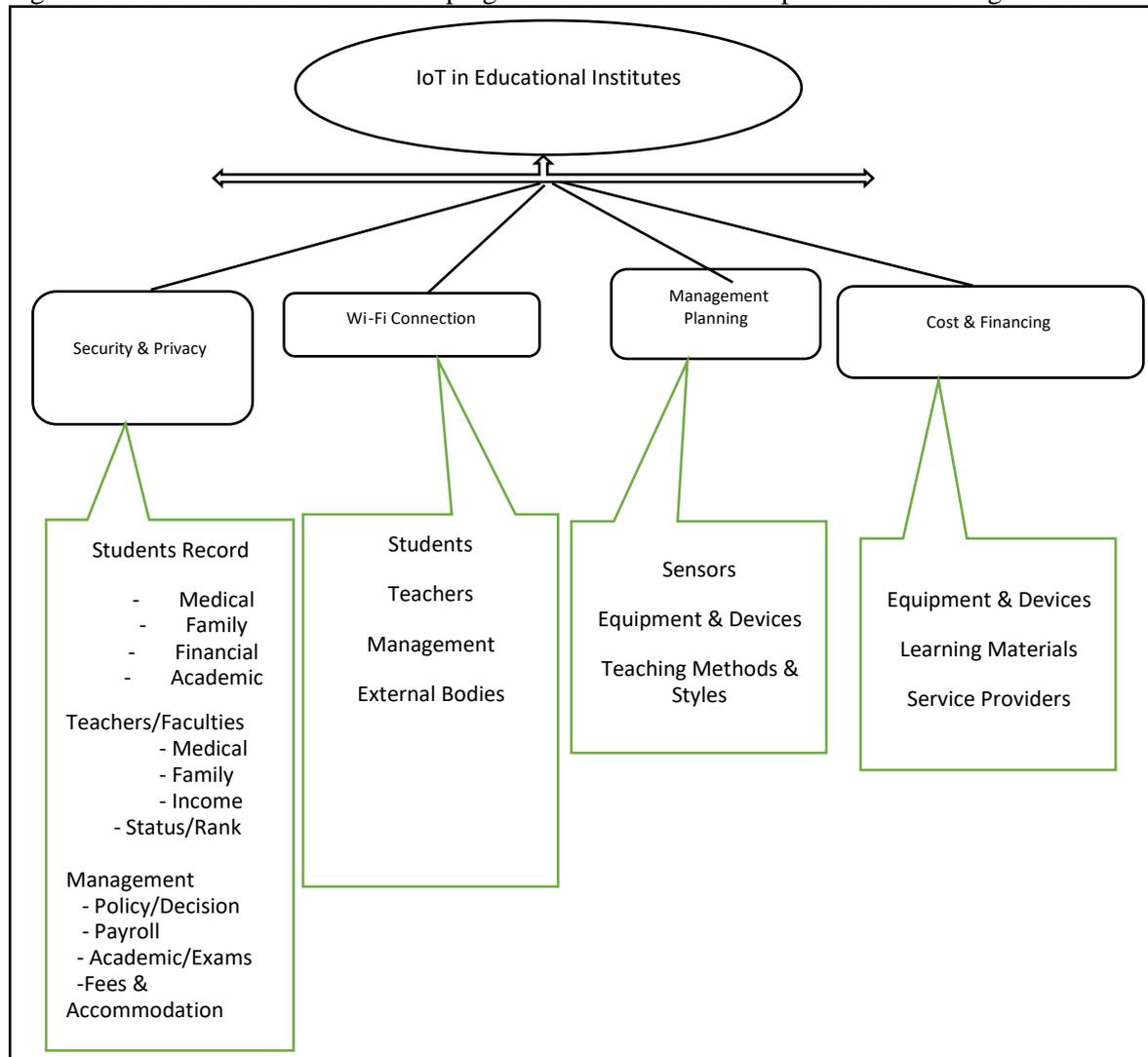


Figure 20: Requirement Model for Adoption of IoT in HEIs

3.7 Models Comparison

This section presents comparisons on the available software models with the proposed AIIMES model so that developers can decide towards adoption and implementation of the framework.

Waterfall Model	Spiral Model	Iterative and Incremental Model	Agile Model	AIIMES
<p>Software model cannot be used at the initial stage of the life cycle</p> <ul style="list-style-type: none"> - It is associated with too much risks and uncertainty - It is not a preferable or good model for complex and object-oriented software projects - It does not support software requirements changes - Measuring project is difficult among within stages since there is no provision for actors' feedback - Project integration is done at the end of the entire process 	<ul style="list-style-type: none"> - There is complexity in terms of management due to excessive use of prototypes - Determining the end of the project may not be known at the early stage of the project since risks is attached to every possible method identified. - It will be expensive and not suitable for smaller or projects with low risks. - Projects may last indefinitely - Too much of excessive documentation on intermediate stages or phases. 	<ul style="list-style-type: none"> - It requires more resources for accommodating parallel developments - Too much dependencies on the risk analysis - It requires highly skilled resources for risk analysis 	<ul style="list-style-type: none"> - Problem in handling complex dependencies - Risks of sustainability, maintenance and extensibility - Absence of Agile leader's input may stop the progress of the project 	<ul style="list-style-type: none"> - Accommodate change in software requirements - Reduces cost of development - It's characterized with many incremental releases - Team members and actors participate in all aspects of the software project - It involves multiple iterative and incremental development schedules to improve output - It provides demonstration at each design of the iteration to actors and take their feedback to next iterative and increment

4. RESULTS

This chapter present the results of the research and it contains both the results on the raw data collected from the survey conducted on the various educational institutes.

4.1 Analysis and Examination of the Current MIS and E-Learning Applications in Higher Educational Institutes in Developing Countries

The first objective of the research is to determine whether MIS and E-Learning applications are existing in educational institutes of developing countries. In this case, it is difficult to examine the entire educational institutes of developing countries. However, the research uses selected

educational institutes in Pakistan and Nigeria. Survey was conducted in these institutes using research schedules and data were retrieved from various respondents.

4.1.1 List of Selected Higher Educational Institutes and Respondents

This section presents the selected institutions from both Pakistan and Nigeria that are used for data collection. The results of the survey are obtained from these institutions. The research schedules were administered in these institutions through the identified enumerators. The institutions are presented in the table below:

Table 1: List of Selected Higher Educational Institutes

S/NO	NAME OF INSTITUTE	COUNTRY	REMARK
1.	Quaid e Azam University, Islamabad	Pakistan	Central University owned by under Govt of Pakistan
2.	University of Balochistan	Pakistan	Central University owned by Government of Pakistan
3.	Mir Chaker Khan Rind University of Sibi	Pakistan	Deemed to be University Approved by Government of Balochistan and Recognized by University Grants Higher Education Commission
4.	University of Turbat	Pakistan	It's an institute was affiliated to University of Balochistan Quetta. Now become University Approved by Government of Balochistan and Recognized by Higher Education Commission of Pakistan
5.	Iqra University	Pakistan	Is a private university approved by Government of Pakistan Recognized by Higher Education Commission of Pakistan.
6.	University of Loralai	Pakistan	Was sub campus of University of Balochistan. Now become University Approved by Government of Balochistan and Recognized by HEC of Pakistan
7.	American University of Nigeria, Yola	Nigeria	Private University Approved by Government of Nigeria and Recognized by National Universities Commission (NUC)
8.	Modibbo Adama University of Technology, Yola	Nigeria	Is a federal government university owned by Government of Nigeria
9.	Gombe State University, Gombe	Nigeria	Is a state government university owned by Gombe State Government and Recognized by National Universities? Commission (NUC)



10.	Gombe State College of Health Sciences and Technology, Kaltungo	Nigeria	Gombe State owned Non-degree College
11.	Taraba State University, Jalingo	Nigeria	State University owned by Taraba State Government and Recognized by National Universities Commission (NUC)
12.	Umar Suleiman College of Education, Gashua	Nigeria	Yobe State owned College. Award Degree in Education Course and also National Certificate in Education (NCE)

Table 1 above contains the list of selected higher educational institutes where data are collected. The institutions consist of central and federal government universities, states government universities, private universities, institutes and colleges.

4.1.2 Requirements Investigation

This section presented the investigative data for the requirements of the process involve on the research schedules from the designated institutions. The processes are mostly activities involving the use of MIS and E-Learning from these institutions. Responses from the responded are recorded on the research schedule by the enumerator.

5. SUMMARY AND CONCLUSION

6.1 Summary

SDM is a procedure or processes that usually helps software project developers in building or implementing software projects. Successful and careful adherence to SDM makes software expansion and development easier and yield desired results to the clients. Though, most software developers don't usually adhere to the development methodologies, they resort to build software projects according to their perceptions and the requirements descriptions provided by the clients.

Adoption of technology into educational system nowadays are very common and fast growing. Most educational institutes in developing countries are using several kinds of application systems in handling and managing academic and administrative activities within the educational institute. However, most of the applications does not follow the existing standard SDM. This is because, despite various SDM in existence, there is no specific SDM for developing educational software or applications especially MIS and E-learning applications. Each developer is building software application according to the description provided by the educational operators in the institute.

Therefore, this study proposed SDM known as Agile Iterative and Incremental Methodology for Educational Systems (AIIMES). The method can be used by software developers for construction and implementation of MIS and E-learning applications in higher or tertiary educational institutes in developing countries. Most application software that is used in education systems are information system driven applications particularly for record management which falls under the category of MIS. Apart from record managements, performance assessment, evaluation and resource (teaching or learning materials or modules) form an integral part of educational institutional activities. This is why AIIMES model or framework captured E-learning into it to enable such processes to be implemented successful.

In the course of the study, field data was collected from twelve (12) selected higher education institutes in Pakistan and Nigeria. Research enumerators were used for the data collection by means of research schedule, and the collected data was used in framing the AIIMES method.

Finally, the research is presented in six chapters. The introduction is done in Chapter one consisting of the background of the study, problem statement, objectives, significance, scope, etc. The literature review was contained in Chapter Two, materials and methods in Chapter Three, results and discussions were presented in Chapter four and five respectively. The proposed models for the framework were presented using figures, while the field data collected on the requirements investigation were presented in tables.

5.2 Conclusion

The central aim of the study is to design an SDM framework that will integrate the implementation of MIS and E-learning in educational institutes. In achieving that, five (5) objectives were formulated. These objectives consist of conducting analysis and examination of the current MIS and e-learning platforms used in higher educational institutes in developing countries, identifying suitable software development methodology for implementing MIS and E-Learning in higher educational institutes, design MIS and e-learning models for higher education system, design models integrating big data into the framework for improving learning and teaching in educational institutes. design models for integration of IoT within the framework for improving teaching and learning in educational institutes.

The collected data from the field was able to make objective one achievable, the data enable the researcher to identify requirements and procedures involves in educational institutes that will be included within the proposed framework. The AIIMES proposed serve as the results for the second objective of the research. UML techniques such as use case, activity diagram and Swimlane were used in designing the models for both MIS and E-learning and also integrating big data and internet of things (IoT) into the educational institutions for enhancing teaching and learning.

5.3 Recommendations

The following recommendations were made at the end of the study:

- i. The proposed AIIMES framework should be implemented and adopted by software developers in developing MIS and E-learning applications in educational institutes.
- ii. There is needs to establish ICT unit at all levels of higher educational institute as well as to recruit information system analysts that will be advising policy makers on suitable development methodologies.
- iii. Despite the success made in achieving the general aim and objectives of the study, more developers can work towards implementing the AIIMES method to ensure its reliability.
- iv. Educational Institutions should make provision for learning platforms using smart devices.
- v. Proper orientation and workshop can be organized for critical stakeholders in order to have proper implementation of software applications in educational institutes.
- vi. E-learning platform should be employed at various aspects of educational institutions.
- vii. Government and regulatory bodies on education should enforce the adoption of E-Learning platforms in addition to the conventional teaching and learning mode.
- viii. Teachers or faculty members should be encouraged to administer or distribute learning materials and tasks to the students using electronic means.
- ix. Software project developers should strictly follow to SDMs whenever they are building, developing, or implementing software solution to their clients.



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