E-learning: Virtual Classroom as an Added Learning Platform in Higher Learning Institutions of Rwanda.

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Declaration

I hereby declare that this thesis work entitled, *"E-learning: Virtual Classroom as an Added Learning Platform in Higher Learning Institutions of Rwanda"* is original has never been submitted to any university or other Institution of Higher Learning.

 This thesis work has been completed under the supervision of. Professor SUNG HAN PARK

Signature……………………………………

Ben RUHINDA

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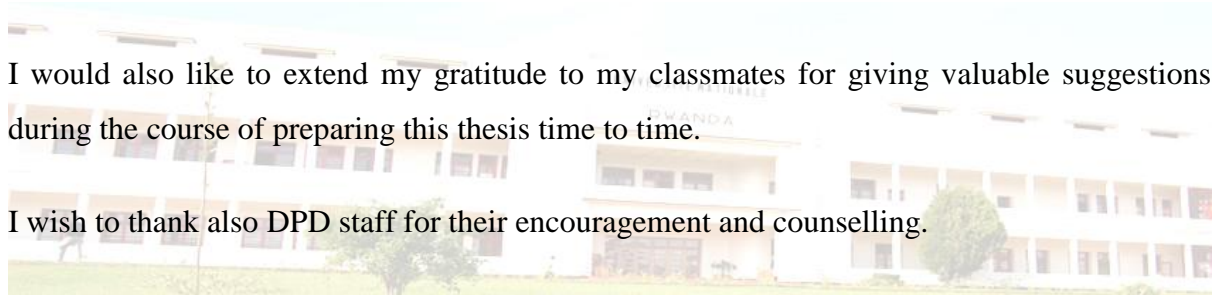
Table of Contents

List of figures

Acronyms and Abbreviations

ACL	Access Control List
AICC	Aviation Industry Computer-Based Training Committee
BSC	Broadband Systems Corporation
CIT	Centre for instruction technology
CMS	Course Management System
DB	Data base
GoR	Government of Rwanda
GSM	Global Systems for Mobile
HD	High Definition
HLI	Higher Learning Institutions
HTTPS	Hypertext Transfer Protocol Secure
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IM	Instant message
IMS	IP Multimedia Subsystem
IPLC	international private leased circuit
IPTV	Internet Protocol Television
KIE	Kigali Institute of Education
KIST	Kigali Institute of Science and Technology
LMS	Learning Management Systems
MIS	Management Information System
MoH	Ministry of Health
Moodle	Modular, Object-Oriented, Dynamic, Learning Environment
MPLS	Multiprotocol Label Switching
NBN	National Backbone Network
NBN	National Backbone Network
NCHE	National Council of High Education
NISR	National Institution of Statistics of Rwanda
NUR	National University of Rwanda
ODeL	Open Distance and e-Learning
RC	Research centre
REB	Rwanda Education Board
ROU	Rwanda Open University
SAAS	Software as a Service
SCORM	Sharable Content Object Reference Model
SIS	Student Information System
SMC	Systems, Man and Cybernetics
SNM	School of Nursing and Midwife
SUMI	Software Usability Measurement Inventory
TTC	Teacher Training Colleges
UMTS	Universal Mobile Telecommunications System
VLE	Virtual Learning Environment
VoD	Video on Demand
VoIP	Voice over IP
VoR	Verification of Requirement
WLAN	Wireless Local Area Network

Abstract

Some of the challenges being face by the Ministry of Education (MoE) of Rwanda are the shortage of teachers, over-crowded classrooms and lack of teaching resources such as textbooks. Alternative teaching and learning platforms are needed to supplement traditional classroom teaching and learning. Virtual classrooms have been proven, in many countries, to offer an alternative teaching and learning platform for students and teachers to engage on an academic level. They have been a widely used in tertiary course delivery, such that some universities offer courses purely online.

However, currently implementations required high bandwidth in order to support the communication tools that they offer, including voice and video conferencing, a shared whiteboard, instant messaging and file sharing. In many developing countries the high cost of broadband internet access is a major deterrent to the country's broadband penetration rate. Users are opting to cheaper subscriptions plans at very slow dial –up speeds. This renders current implementations nonviable due to their high bandwidth requirements. As a result, virtual classroom applications that require minimal bandwidth have become necessary as a viable supplement to traditional classroom teaching and learning. Minimizing the bandwidth requirement of virtual classrooms is a key to its wide adoption by general users with low bandwidth speeds.

One of the aims of this research is to study the use of the Virtual classroom platform; this method of facilitating whiteboard updates will require some level of intelligence on the client side to process the received text in order to update the whiteboard appropriately. The virtual classroom framework that is proposed leverages on the security provided by IP multimedia subsystem network as well as its ability to support simultaneous mode of communications (video, audio, text) through SIP. The delivery platforms are able to offer Quality of Service (QoS), Quality of Experience (QoE) and security.
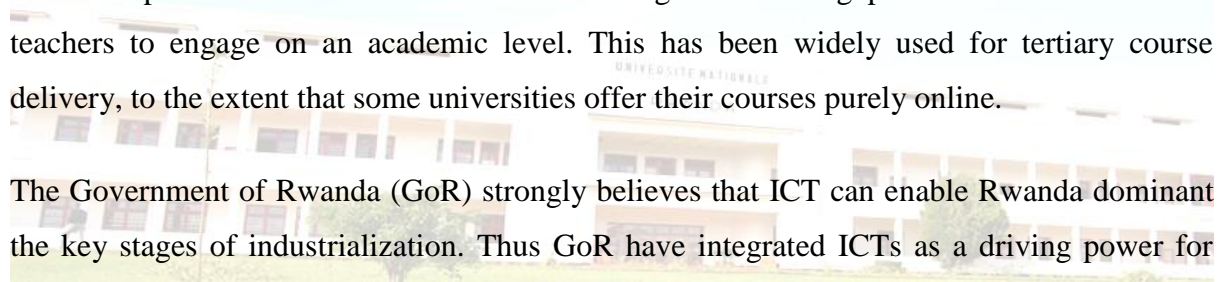
As real-time application, the research will propose frameworks that adhere to real-time communication time constraints.

Upon completion of the research, an evaluation platform will be recommended for implemention and aiming to measure QoE of virtual classroom service.

Chapter 1: Introduction

1.1.   Background

Information technology has made a significant impact on global development; every country has a development plan to implement in regards to use of Information and Communication Technology (ICT). Rwanda as a developing country is also encouraging the use of ICT service delivery countrywide in order to optimise resource usage by enhancing the quality of service. Some of the challenges being faced by Ministry of Education of Rwanda are the shortage of teachers, overcrowded classrooms and lack of teaching resources such as textbooks. There is a need to adopt the use of educational processes that utilize information and communications technologies to mediate asynchronous as well as synchronous learning and teaching activities; this solution, that supplements the traditional classroom teaching and learning, is known as 'e-learning' or 'the virtual classroom'. The use of virtual classrooms has been proven to offer an alternative teaching and learning platform for students and teachers to engage on an academic level. This has been widely used for tertiary course delivery, to the extent that some universities offer their courses purely online.

The Government of Rwanda (GoR) strongly believes that ICT can enable Rwanda dominant the key stages of industrialization. Thus GoR have integrated ICTs as a driving power for socio-economic development and to fasten the speed of Rwanda's transformation to a knowledge-based society National Information Communication Infrastructure Plan 3 (NICI III Plan 2011 - 2015). The key objectives of National Information Communication Infrastructure (NICI) are to: transform Rwanda into an IT-literate nation; promote and encourage the deployment and utilization of ICTs within the society; improve the civil and public service efficiency; improve the information and communications infrastructure; make Rwanda a regional ICT hub; transform the educational system and enhance skills development leveraging ICTs thereby developing a human resource base that adapts to changing demands of the economy; and develop the legal, institutional and regulatory framework and structures required to support ICT development.

As else on the planet, Rwanda population is benefit to the wide spread of Internet and able to access virtual classrooms services. The growth of Internet is directly related to the increase of information and communication technology as well as decrease of the cost. The capacity

of ICT to support multimedia resource based learning and teaching is also relevantly growing.

1.2. Research questions

The following research questions will be focused;

    i.   What uses of virtual classrooms with optimised bandwidth utilization are feasible as an option in Rwanda?

    ii.   What are possibilities of using virtual classrooms to supplement traditional classrooms in Higher Learning Institutions (HLIs)?

    iii.   Which is the most suitable framework for supporting services?

1.3. Internet usage

The research will investigate the current state of ICT infrastructure in Rwanda. Rwanda and Africa at large have lagged behind in the development and deployment of Internet access, resulting in limited access to high bandwidth and large scale internet infrastructure. Recently there is rapid change in the number of Internet users in Rwanda. The majority of the increase is due to the business sector and higher education institutions. However, this number of the population with Internet access is very low when compared to developed countries as depicted in Figure 1.

Internet users as percentage of population
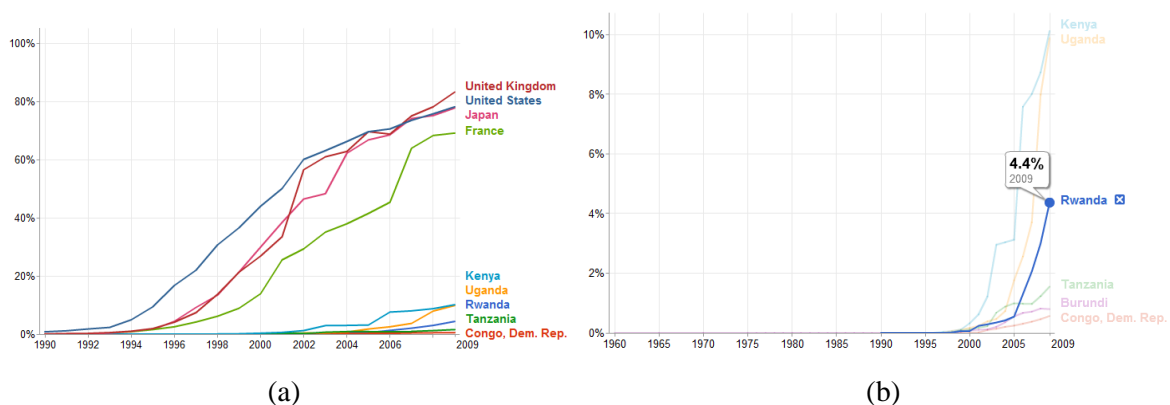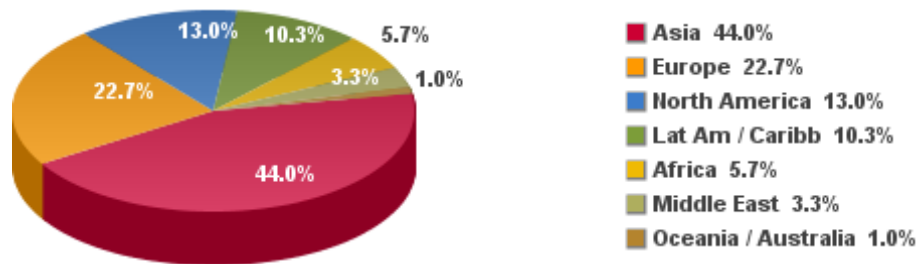

(a)   (b)

Figure 1: Developed countries verse developing countries internet usage 2009

Figure 1(a) depicts the percentage of country's populations that have access to internet or use the internet. This percentage is plotted over several years. Figure 1(b) 4.4% of Rwandan

population in the year 2011 use internet. Notably, each countries plot shows an increase in the number of people that have access to the internet. Figure 2 shows the World distribution by world Regions – 2011, much of the increase can be attributed to several Telecommunication Companies and increased bandwidth availability.

Internet Users in the World
Distribution by World Regions - 2011

Region	Percentage
Asia	44.0%
Europe	22.7%
North America	13.0%
Lat Am / Caribb	10.3%
Africa	5.7%
Middle East	3.3%
Oceania / Australia	1.0%

Source: Internet World Stats - www.internetworldstats.com/stats.htm
Basis: 2,095,006,005 Internet users on March 31, 2011
Copyright © 2011, Miniwatts Marketing Group

Figure 2: Internet users in the World -2011
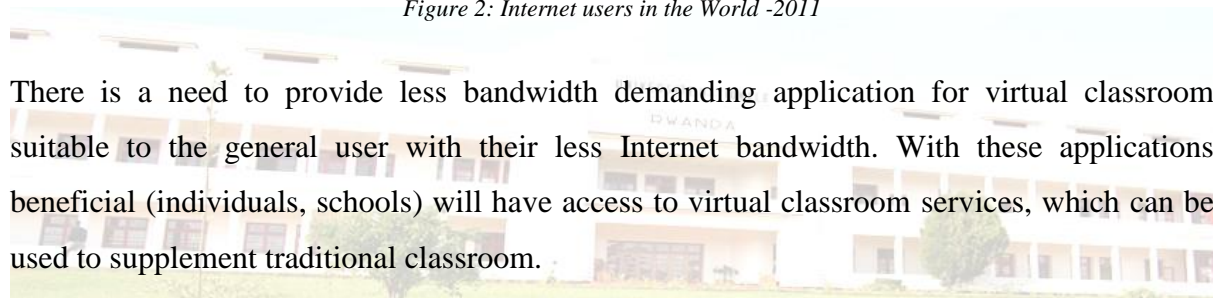
There is a need to provide less bandwidth demanding application for virtual classroom suitable to the general user with their less Internet bandwidth. With these applications beneficial (individuals, schools) will have access to virtual classroom services, which can be used to supplement traditional classroom.

Advances in technology such as streaming both audio and video, however, mean that virtual learning needs a stable and suitable infrastructure with optimum bandwidth. In under-developed countries such as Rwanda, the high cost of broadband internet access is a major deterrent to the country's broadband penetration rate. Users are opting for cheaper subscriptions plans at very slow dial-up internet speeds. This renders current implementations nonviable due to their high bandwidth requirements to support the communication tools that they offer, including voice and video conferencing, a shared whiteboard, instant messaging and file sharing.

There are a variety of e-learning platforms applicable for educational purpose; this research will focus on assessing and analyzing Rwandan educational infrastructure network and its ability to sustain the implementation of e-learning platform. This will also analysis different platforms and give some perspective for future implementations plans for the preferable platform.

1.4.   Aims and objectives;

This research will guide the researcher and policy makers in Education sector to choose an appropriate and suitable architecture of e-learning platform that is applicable to the education network of Rwanda. The following are research objectives;

- To investigate the feasibility of sharing whiteboard and update it during a virtual classroom session, with the aim of minimizing the bandwidth requirements of virtual classroom applications.
- To investigate the number of students and schools in Rwanda who have access to computers with internet access, to virtual classroom services. And to provide an overview of the current state of Rwanda's communication infrastructure and its ability to support virtual classroom applications.
- To evaluate the implementation of a virtual classroom application with support for voice conferencing, shared whiteboard, Instantaneous Message (IM), presence and file sharing, that maintains real-time communication.

Chapter 2: Review of virtual class room technologies

2.1. Background information

The emergence of the World Wide Web (WWW) has paved the way for a new system of academic learning. Traditional methods of academic learning which involve people being in a single venue at a specific time for learning to occur is fast becoming unsuited to the lifestyle of many people today.

The Internet opens doors for new academic learning paradigms. Online classes have become more popular over the last decade. E-Learning grew by 86% between 2006 and 2008 in regard to the total number of courses delivered. Virtual Classrooms in the same light grew by 33% within that same period [1]. These percentages are a clear indication that more students are taking-up online courses as opposed to traditional classroom classes. The popularity of online classes has grown so much that some university programs are purely online based, offering all their courses over the Internet [2].

In another research based on the pilot evaluation of Learning Activity Management System (LAMS) [3], 80% of students preferred to discuss their ideas in a virtual environment, while only 15% preferred a physical classroom.

Based on the scale of accepted theory of Educational psychologist by William Glasser, states that we learn by; 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we see & hear, 70% of what we discuss with others, 80% of what we experience and 95% of what we teach someone else. E-Learning that includes student interactivity and personal involvement in the learning process has the potential to successfully deliver the highest student learning possible (just short of them teaching someone else). Thus, eLearning can be highly effective, if designed properly [4]. This further highlights the paradigm shift in student experience – student interaction and learning in general.

2.2. E-learning Models

The intentional use of ICT in education support what is referred to as e-learning; it encompasses learning at all levels, both formal and informal, from simple tutoring to the delivery of whole courses. ICT in e learning refers to a diverse set of tools and resources used to communicate, create, store and manage information. These tools and resources include

computers and the internet, telephones, television and radio. Online learning was made possible by integrating ICT into education.

ICT enables students to take courses online. As an internet based academic learning platform, students taking online courses require computers with internet access in order to access course content, assignments and tests. E-learning course deliveries are usually achieved through two design approaches; asynchronous (non-real-time) and synchronous (real-time) each with its own pros and cons. The two approaches are briefly presented:

- **Asynchronous (Non-real-time) Model**

Online e-learning is referred to as asynchronous learning. Students work independently through a set of course objectives and correspondence among themselves as well as with the instructor happens via email and discussion boards. The students are often given a time frame in which to perform given tasks.

- **Synchronous (Real-time) Model**

The synchronous approach often involves the use of a virtual classroom to aid course delivery. With this model, students engage with the instructor on a real-time basis. Communication between student and instructor communication occurs through audio, video, instant messaging and usually a shared whiteboard interface. Virtual classrooms grew more popular among students, due to their real-time nature, as it gave them the opportunity to address issues concerning course materials during the lesson delivery.

2.3. Virtual Classroom Architectures

The functional needs of a virtual classroom may differ depending on what it is used for.

Virtual classrooms may be used to teach or used to discuss business related matters from various parties involved (business meetings, brainstorming sessions). Two main virtual classroom architectures exist to cater for these two scenarios. These are discussed below.

2.3.1 Role-based Architecture

The role based architecture is implemented in "a multiple distance learning System on the internet as described in the conference proceedings of IEEE SMC'99" [5], [6] and in other

online web based services [7]. In this case the virtual classroom is used for teaching a group of individuals. In this architecture each participant is assigned a specific role. The different roles include:

- Teacher (Instructor) act as a facilitator of a classroom session. They also develop courseware to be taught during sessions.
- Class expert helps students solve technical problems (such as no sound, microphone problems, etc) that they may encounter during a session.
- An administrator is responsible for maintaining all aspects of the distance learning and all aspects of the learning system such as user access rights and student registrations.
- The team leader is a person in charge of a group when students are divided into groups. The team leader may also be in charge of the whole class when the teachers/ instructors are absent.
- Students are the people who access the course content. That is, the people who are taught by teachers/ instructors.

Each of the roles has a set of responsibilities and privileges. For example, in some literatures, the teacher has control over the microphone and the whiteboard facilities. Having access to the microphone gives the teachers the privilege to speak while the rest of the class listens.

The teacher also has the ability to grant participants access to these facilities. A role policy is used to assign roles to participants. The implementation of the role policy differs and is subject to the designer's preference.

Some authors allowed students to switch between roles, giving them different privileges. This is particularly useful during break away sessions, where different students can take up the team leader role.

2.3.2   Collaborative Architecture

Another approach to virtual classroom architectures is based on the notion of collaboration.

Collaboration is at the forefront of a variety of classroom techniques that are currently being advocated. Collaboration is based on the notion that students master certain subjects better

when they work in groups with equal "rights" rather than as individuals. Furthermore, group work is beneficial to problem solving.

Collaborative learning is a well-established group work method that provides a useful alternative to teacher-fronted classes. Collaborative learning has other benefits in the context of teaching and learning, including developing the students' social interaction skills, communication skills and much more due to its "all participants are equal" policy.

Traditional classrooms foster group work for certain activities and as a result virtual classroom applications need to adhere to this requirement. Commonly found in virtual classroom course delivery sessions is what is known as "break-away" teams. During a session, a facilitator may group certain participants together to form smaller groups. These groups are given a subject to discuss or a problem to solve and after the allocated time has elapsed, the assigned team leader reports back to the larger class. These "break-away" teams resemble traditional classroom setting where a teacher divides the students into groups to work through a certain problem.

This architecture does not define any roles and all participants are considered equal. This kind of virtual classroom architecture will be better suited for business meetings or business brainstorming sessions where all parties are given the same privileges.

2.4. Building Blocks of Virtual Classrooms

Recent trends in technology points towards the integration of services into single devices. Just over two decades ago one had a television set, a video recorder and a hi-fi system for entertainment (video and audio) but today, a single computer will suffice. Printers now do more than just print papers, but perform other functions like scanning, photocopying and emailing. It is clear that people want single devices that do more for them than having multiple devices performing different but related functionalities. Cellular phones are the winners in this regard. These communication tools provide support for both collaborative and individualized communication. The following subsections discuss the different building blocks of virtual classrooms.

2.4.1 Whiteboard

A whiteboard is mostly seen as the main feature of a virtual classroom and sometimes referred to as the "chalkboard with an electronic edge". The idea behind it is to mimic traditional blackboard functionality as best as possible. The physical board is represented by a white rectangular drawing space. The chalk is replaced by either the mouse or an external electronic writing pen. These whiteboards are equipped with tools that allow users to draw shapes (triangles, rectangles, circles, etc), text and free hand drawing. Whiteboards are further equipped with colour selection menus and a variety of text editing tools. Some virtual classroom implementations have support for power-point presentations to accommodate modern presentation styles. Slides are viewed by all participants yet controlled by the facilitator of the session. A means to broadcast the content of the shared whiteboard to all participants poses a challenge for virtual classroom designers.

WiZiQ [6] recently implemented a screen sharing feature. This feature uses a screen sharing codec' that transmits the presenter's screen as a series of images at a specific frame rate to the server, which in turn transmits these images to all attendees' screens [8]. The screen sharing feature has been optimised for users with 500Kbps data transfer rate, these are too slow to support what WiZiQ offers.
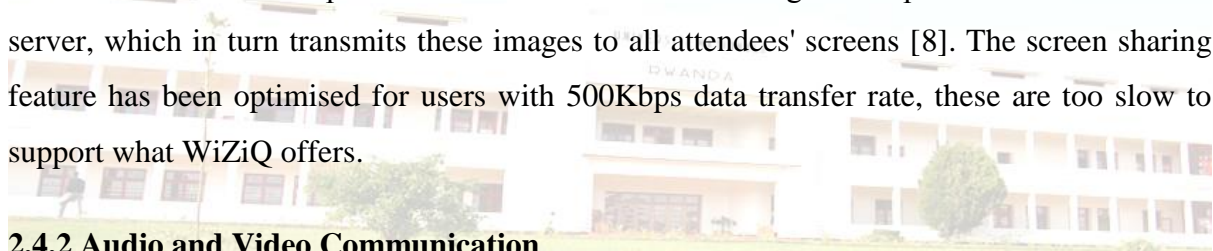
2.4.2 Audio and Video Communication

Video communication is known to be one of the major bandwidth consumers in virtual classroom applications. Bad implementations result in heavy delays which lead to a low user Quality of Experience (QoE). Advances in High Definition (HD) video over the Internet brought advances in both visual quality and narrowing of Round trip latency for realistic dialog. Video quality and clarity allows students to better engage with the instructor and maintain student attention during a session.

Audio quality is vital to student's clear understanding of the offered content– it might be the worst distraction of a session and needs to be the one aspect that is well maintained (difference in quality is user equipment dependent). A truly interactive communication requires timely and high-resolution video and audio transmission over a network, with end-to- end latency below 100 ms. even when captured and transmitted independently, the video

and audio must be kept synchronized and thus both transmitted with the lowest latency. A broadband connection is required in most cases to achieve this.

Yang et.al [9] proposed the use of text to speech technology to reduce the bandwidth requirements of virtual classroom applications. Textual files are generally smaller and can be transmitted quickly when compared to video and audio files. The added advantage of their system is that the user does not have to read all the time but could listen to what was being said while concentrating on the whiteboard presentation. The disadvantage, however, of the system was that the synthesizing quality of the engine was not very good, resulting in bad audio quality. Bad audio quality is known to lead to low user QoE of the virtual classroom application.

2.4.3 Instant Messaging

Instant Messaging (IM) is a form of real-time communication between two or more people based on typed text messages. It requires the least bandwidth when compared to other virtual classroom communication tools such as video and audio calls, and can be the fastest means of communication during a session when there is limited bandwidth. IM has proved to be a very useful communication tool in a virtual classroom setup.

A major advantage of IM is that it complements visual communication for the audibly impaired members of a session and helps those who cannot support video and audio to actively engage in a session. IM is synonymous to students passing small notes around to one another during a group session. These messages can either be public whereby all members of the session are permitted to read it or private where only a limited set of persons are allowed to read it.

2.4.4 Feedback Mechanisms and Interactions

A virtual classroom requires a means for the facilitator to ask questions and get feedback from the students attending the class when used for teaching. With certain implementation, the facilitator is the only one who controls the microphone, hence giving access to individual students one after the other which may prove time consuming and very ineffective. As a result, virtual classrooms are equipped with polling mechanisms, that allow a facilitator to

ask general questions and all participants can answer simultaneously by selecting an answer of their choice. The results are visible to the teacher.

2.4.5 Resource Sharing

Resource sharing refers to the distribution of course content prior to, during and after a virtual classroom session. Students are given access to course related material such as presentations slides, worksheets, assignments and past virtual classroom sessions.

2.5. IMS Features that Enable Support for Virtual Classrooms

As discussed in the previous section, virtual classroom applications combine several services into one application. These services include voice calling, video calling and instant messaging. Each of these services comes with its own set of Quality of Service (QoS) requirements. Some commercial implementations of virtual classroom applications are offered over the open Internet. The Internet is a best effort network, meaning communication is unreliable and can often be intermittent. This is not ideal for conference calls (business or teaching) and can be extremely annoying to the end user. Furthermore, security cannot be guaranteed over an unmanaged platform. It is possible to offer reliable and secure IP based services by using managed service delivery platforms. Virtual classroom applications need to run over highly managed Service Delivery Platforms (SDPs) which provide QoS guarantees.

The IP Multimedia Subsystem (IMS) is an architectural framework which provides the necessary control functionality required to run managed SDPs over Next Generation Networks (NGNs). This network shifts the focus of network providers from access provisioning to service provision. IMS allows for the horizontal integration of applications, which are being developed and deployed at an alarmingly rapid rate. However, its wide acceptance relies heavily on how best network providers differentiate their services from existing services over other non-IMS networks. This service differentiation can be done by increasing security, greater service integration and improved reliability through QoS provisioning [10]. Virtual classroom applications are a means to integrate existing services such as voice, video and text communication. The IMS offers service integration support, required by virtual classroom applications, through Session Initiation Protocol (SIP's) ability to offer simultaneous communication modes (voice, video, IM). The simplicity of the IMS with regard to session setup and termination together with its architecture, which separates

the core entities from the application layer, allows for easy incorporation of new applications into the network. This will allow ISP's to easily integrate a virtual classroom application into their network. Users have full access to all applications, including Voice over IP (VoIP), Video on Demand (VoD), Presence, Internet Protocol Television (IPTV) and many more that are deployed in the application layer. These existing services can be harnessed to provide a more comprehensive virtual classroom experience. For example, recorded virtual classroom sessions could be offered as VoD, leading to another source of income for ISPs. Furthermore, the IMS is access network; independent of hence can be used over a Global System for Mobile Communication (GSM), UMTS, WLAN and Broadband connections. Users do not need to have multiple accounts to access the various applications. Therefore, IMS flexibility enables virtual classrooms to be offered over any access network technology, fixed, mobile, wired or wireless.

2.6.   Discussion

Virtual classroom applications have the goal of replicating traditional classroom settings, from teacher to student and collaborations between students. Reviewed literature shows vendor specific implementations, for example a typical classroom requires students to pay attention to the teacher as a lesson is delivered. Paying attention to the teacher however, places no limits on students interacting with one another to clarify something the teacher said but they did not understand.

Current implementations, specifically WiZiQ [6] and Elluminate [7], gives the teacher full control of the microphone (audio communication). Only one person can be speaking at any given time. A student would have to disrupt the whole class by requesting permission to get the microphone prior to asking a question which a fellow student perhaps could have explained privately. This is not in-line with mimicking traditional classroom settings where a student is free to ask a quick side question without disrupting the whole class session. Students also have the choice to choose whom they are listening to at any given time. This freedom is not incorporated in current virtual classroom applications.

Furthermore the chat feature offered by applications of this nature is usually multi-chat. This means that everyone can read what the other says. Some implementations that support private chat also give the teacher the ability to disable it. This again is not in-line with traditional

classroom settings where private conversations, although not ideal, are not inhibited from occurring.

Virtual classrooms that take into consideration the freedom of students in a physical classroom are imperative to be best accepted among young users.

Several common practices and tools with regard to virtual classrooms are identified and used in the design of the proposed framework discussed in the chapter four.

Chapter 3: Methodology

3.1. **Research design**

The research design in this research is the type of comparative evaluation; this is because it will evaluate the current states of existing systems on the users' perspective on use of virtual classroom in Rwandan education network. Systems were pre-selected based on technical and financial features and the interactivity on e-learning platform in Ministry of Health, School of Midwife and Nursing and National University of Rwanda.

3.1.1. Sampling (Target group)

Since the research is dealt with learning, the target population are the student in case study institutions and their respective lecturers. The sample to be used in this research will be random and it will sample at NUR and MoH, School of Midwife and Nursing.

3.2. Tools for data collection

3.2.1. Primary collection tool
3.2.1.1. Questionnaire

The questionnaire used interviews as the primary collection tool. The questionnaire will be distributed to the student in two institutions (MoH and NUR).

3.2.1.2. Interview

Interviews will be conducted to get data which can only be obtained when there will be interactions between researcher and the target population. This will be greatly used as a follow up for the questionnaires.

3.2.1.3. Observation

The observation via public pages of pre selected e-learning platforms will base on the technical requirements and financial cost.

3.3. Data recording

The data record will be done by use of a pen and a paper during interviews and online questionnaire are to be completed.

a. Data analysis

Data analysis will be done using statistical tools and it will be presented in table, graphs and pie charts.

b. Issues addressed in the e-learning platforms

So far, there is no big observation this research but some issues are disclosed while others are no disclosed. The following will be focused on;

- Usability of the e-learning and platform
- Interactivity of the e-learning platform
- Technical and pedagogical feature
- Data transmission in terms of bandwidth consumption and systems architecture with regards to DB accessibility and Access Control List (ACL)

c. Evaluation method

The analysis in regards to the usability, in this research Software Usability Measurement Inventory (SUMI) an evaluation method will be used.

d. Scope and limitation of the research

The research is limited to the Education network of Rwanda and more focused on above-mentioned case studies. The two institutions have implemented e-learning platforms. The limitations are not emulated yet.

Chapter IV Results of Findings, analysis and discussions,

Chapter 4 presents the research investigations done to understand on what type of eLearning is currently being used in Rwanda compared to the eLearning technology and where it is applicable and if this process is successful? The case studies chosen are Ministry of Health (MoH) of Rwanda and Rwanda Education Board (REB). The sample was random based, the questionnaire were given to students from NUR and from Schools of Nursing and Midwifery in Byumba. Lecturer responded the interview conducted by the research from NUR and SNM of Byumba, Technical and expert staff from NUR, KIE, MoH and Broadband Systems Corporation (BSC).

4.1.   The using virtual classrooms in HLIs to supplement traditional classrooms

4.1.1.   Usability of eLearning in HLIs

4.1.1.1.   The statistics of HLIs population using eLearning in Rwanda

According to *NCHE & NISR Higher Education census July 2012,* there are 31 Higher Learning institutions in Rwanda whereby 15 public, 14 Private and 2 Government aided. The HLIs are classified into 5 categories; 5 Universities, 13 Institutions, 1 School, 4 Polytechnics and 8 Colleges. Most of these HLIs are located in urban areas; 24 are located in urban while 7 are located in rural.

4.1.1.2.   Background of the schools of Nursing and Midwifery host by MoH

According to the National Council for Nurses and Midwives of Rwanda (2009), about 5,000 associate nurses who applied for registration currently serve in the national healthcare including district hospitals and health centres. The capacity of these nurses and midwives needs to be upgraded to A1 level, which is the reason why the MOH is embarking on this e-learning research. Whereas the existing teaching programmes were fulltime in operating in 5 Schools of Nursing and Midwifery only admit about 100 at A2 nurses per year, the e-learning research has taken on board 320 registered nurses in 2012 and they will upgrade the level of education upgrade diploma.

4.2.   Results of research interview with experts from MoH.

In accordance to research question the interview will address the need to develop an eLearning platform for School of Nursing and Midwife.

The experts describe the current need of eLearning as a key solution for the nurses, to be able to improve their skills. The current the teaching in SNM is blended learning which means that they are using numerous forms of learning activities. Blended learning is a combination of three models of teaching; classroom, learning experience and eLearning. In this learning approach instead of students staying at school for the whole academic year, they get a break monthly. They gain more experience when by spending two weeks at school and another other 2 weeks at work performing and gain more experience.

MoH have improved teaching skills for the teachers of Schools of Nursing and Midwifery where at 10 teachers in each school of nursing and midwifery have been trained as eLearning teachers, thus a total of 50 teachers trained. All e-learning students have been trained and at least 70% is able to use e-learning resources successfully

4.2.1. The effective eLearning tools, techniques and technologies

In order to have an effective eLearning systems, three specific categories of actors in eLearning design and utilisation where considered; producers, host, and the learners. The producer consists of the authors, designers, illustrators (MoH- team) and programmers who are involved in the creation of eLearning. The host consists of organisations and equipments utilised to provide the e learning to students. The learner is the end user that benefits from the platform the e-learning service. According to the categories of people and technology used in Rwanda, web based technology is more preferable and applicable. MoH consulted the educational experts in order to develop the e-learning platform, whereby National university of Rwanda Centre for instruction technology (CIT - NUR) was consulted.

4.2.2. 2012 Intake of e-Learning Students attached to each School of Nursing and Midwifery (NSM)

MoH have established schools of nursing and midwifery service, with a mission to improve the skills and ability of Nurses and midwife in health sector, Currently these schools are operational in three parts of the country (Northern 1, Southern 1 and 3 in Eastern), more than 315 students are enrolled and regular participating in their respective studies of which 51% are female and career wise 44 % are Heads of health centres and 56% are Nurses from different health centres and hospitals across the country.

In order for MoH to get the platform, MoH has worked with NUR. They had to call out the verification of requirements (VoR)**,** which focused on 3 aspects. Those aspects are a) Infrastructure and facilities b) Curricula (Content organization, Approach to teaching and learning with Moodle and Assessment) and c) ICT skills (Computer skills, E-resources, online databases). Below are the findings on VoR before implementation of E-learning in SNM;

4.2.3. Infrastructure and facilities

Computer labs: Only one of the schools has an appropriate computer lab to facilitate E-learning, Internet connectivity on two schools have appropriate connection infrastructure. out All schools have a skills lab, Library and a library and required Classrooms.

4.2.4. Curricula & pedagogical aspect (Content organization, Approach to teaching and learning with Moodle and Assessment)

Teaching staffs were assigned extra duty for providing soft copies that will use e-learning content. There was a need to have E-learning coordinator for the Management of the programme, Moodle will help a lot in content management as Learning Management Systems (LMS), Quality and e-learning; The MoH has a request for the employers to be avail more time on the workloads and the students to get time for attending face-to-face sessions and also time for learning.

4.2.5. ICT skills

Basic Computer skills: Teachers responded that they have basic computers skills, but they are not aware of utilization of E-resources and E-learning. The E-learning coordinator was appointed in order to coordinate the new initiative and ensure that the program in operational.

In order to mitigate the challenge, the schools were equipped with networked computers room, servers was brought and hosted in the MoH and students were requested to come with their laptops and modem. The staffs were trained on development of online course and E-resources. ICT related courses such as ICT skills and use of E-learning platform were introduced a course within curricula Midwife and Nursing. A checklist to ensure quality in E-learning with a number of factors has been respected. The factors are; Institutional, Technological, Instructional Design, Pedagogical, Student Support and Teachers' Support and Evaluation.

4.2.6. Mode of delivery

Among numerous types of eLearning, MoH have identified upfront the way to present eLearning training material Thus MoH has identified the blended learning because they run a combination of classroom, learning experience and eLearning.

In ensure the quality of Education, in this School of Nursing and Midwife has enrolled 140 heads of health centres (44%) and 175 Nurses (56%) in all location, The assessment of Learners undertaking this course is assessed through continuous assessment and summative assessment. i) Continuous Assessment is individual assignment on 5%, Group project on 5% and Test on 30% ii) Summative Assessment is One paper for 3 hours assessed on 60%, thus sum-up to 100%. During class time student stay to the school for 2 weeks, learning by face to face from the lecturers, then after they have to set off.

MoH Platform is running on Moodle 2.0.2 (Build: 20110221) with more than 411 users both students and staff. It is hosted in MoH at url: http://www.elearning.moh.gov.rw

. Moodle is the acronym meaning; Modular, Object-Oriented, Dynamic, Learning Environment. Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It is a free web application that educators can use to create effective online learning sites, it is an online

Learning Management System, a web application designed with a purpose of helping educators to create courses accessible to enrolled students through internet [1]. The Moodle was chosen as based on type of licensed, Moodle is an open source it is preferred beyond licensed and company's proprietary platform.

4.2.7. Features of Moodle platform

Each user on Moodle site has an account that contains profile information, forum posts, blog entries, and activity reports. In this account the user will be able to access more common features such as; the main menu, courses, calendar and news, while the administrator portal has also the menu for settings;

Table 4.1: Activity types of moodle

Activity type	Description
Assignments	A tool for collecting student work, either uploaded files or assignments created on- and offline
Chat	A chat room where people can meet at the same time and send text messages
Choice	A simple poll
Database	A tool for creating shared collections of data
Forum	Threaded discussion boards—a powerful communication tool
Glossary	Dictionaries of terms that you can create for each week, topic, or course
Lesson	A set of ordered materials that uses questions to determine what content the student sees next
Quiz	A web-based quiz with a variety of question types, such as multiple choice, true/false, short answer, and matching
SCORM/AICC	A tool for enabling SCORM or AICC (Aviation Industry Computer-Based Training Committee) packages to be included in the course
Survey	Gathers feedback from students using pre-packaged questionnaires
Wiki	A collaboratively edited web page

4.2.8. Analysis of usability of moodle platform according to school of Nursing and Midwife of Byumba.

The research coded the result gathered from questionnaires based on the data got from the questionnaire. The table below show the distribution of the findings from respondents.

Table: 4.2 Frequency analysis of usability perception of moodle platform at school of Nursing and Midwife of Byumba.

Coding of the questionnaire from students

Usability factors	Frequency (Yes)	percentage
Efficiency	28	56%
Effect	14	28%
Helpfulness	34	68%
Control	12	24%
Learn-ability	30	60%
Satisfaction	21	42%
Memorability	9	18%

Justification for the response rate

The sample population was subjected to random sampling; therefore the low response rate is justified due to the application of random sampling.

Corner (2007) state that if you have got a properly random sample, and the people who response are just random within the sample, then you will still have random sample no mater small response.

The random sampling in the research ensured statistical representation of the sample size

4.2.1.1. Explanation of the analysis of the students' perception on usability

Moodle scores high in the field of efficiency due to the students feel that the eLearning platform is simple in downloading notes and economical in terms of having soft copies of notes without paying money for photocopying the handouts. The students who use moodle urge that it is more convenient since they have fulltime access on the platform and course works. This is a greatly contributed to that fact that moodle is helpful and easy to learn-ability. The users control aspect of the platform score low with student argument that the platform does not give them the opportunity to take control of their action in case they select component by mistake.
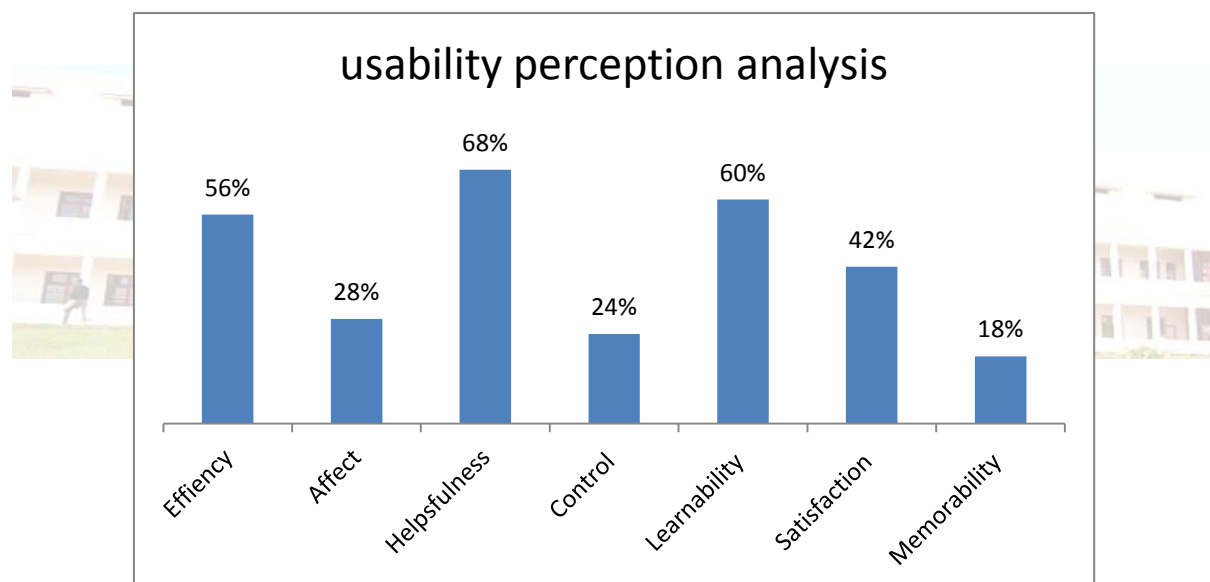

Figure 3: Evaluation analysis of usability of Moodle platform using SUMI method

4.2.1.2.Snapshots of moodle platform

a. Snapshot showing the login

Figure 4: Screen shot of MoH E-learning portal front page

Student logs on using the unique user name created during registration, it serves are the username to enrol on the courses.

Chats and forums are powerful features for collaboration; chat module is a simple synchronous communication tool allowing you and your students to communicate in real time. If you've ever used an instant messaging system like internet chat, a similar system can be used on Moodle chat, Forums are a powerful communication tool within a Moodle course as well which enforces students to interact. These features facilitate students to have instant message communication across the country between student to student or even a lecturer.

b. Navigation menus on the system
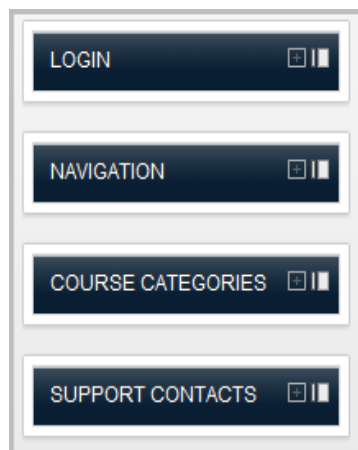
i. **Main menus**   ii. **Navigation**   ii. **Calendar and Online users**
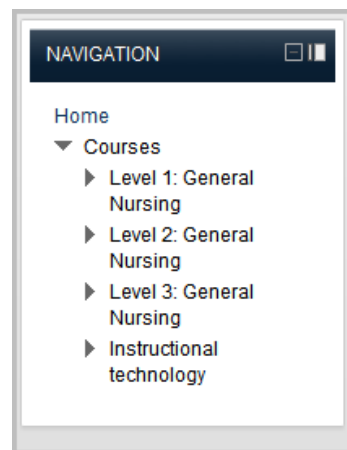
Figure 5: Screen shot of MoH portal menus

4.2.1.3.Analysis of the interactivity of Moodle platform according to SNM of Byumba

The research carried an evaluation of students' perception on the interactivity of Moodle platform and the table below illustrates the results according to the respondents

Table 4.3. Frequency Analysis of interactivity perception of Moodle platform at SNM Byumba.

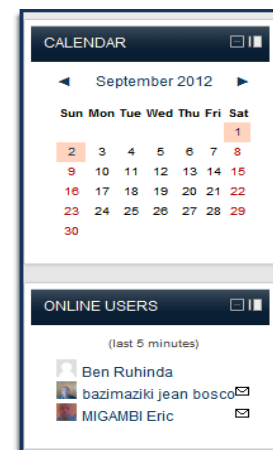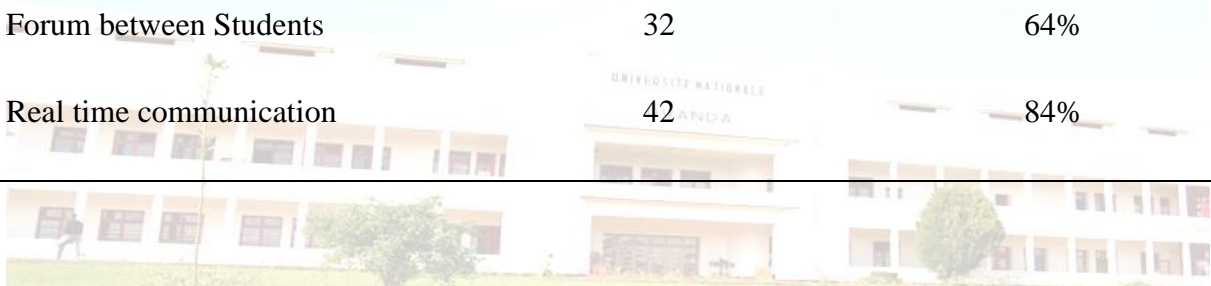| Interactivity factor	Frequency	Percentage
Liner interaction (Listen)	0	0%
Liner interaction (Read)	50	100%
Response - practice with feedback	50	100%
Forum between Students	32	64%
Real time communication	42	84%

4.2.1.4.Explanation of the students' perception on interactivity of Moodle

Students confirm that the Moodle platform is very efficient in content delivery but has an inactive aspect to interactivity to interactivity of linear thus the platform offer purely linear interactivity which is text based. The Moodle platform score low 0 in linear interaction listen with no student giving it score in its capacity to facilitate them to listen. The platform score fairly in allowing students to collaborate and exchange views over the forum and real time communication. Even though these feature are available in this platform, the students argue that low score of forum between student and real time communication is due to the workload and duties they are assigned in the period on being off the campus. The figure 6 below illustrated the general notice to student enrolled to a course of nurse care and there are informed about syllabus and quiz schedule.
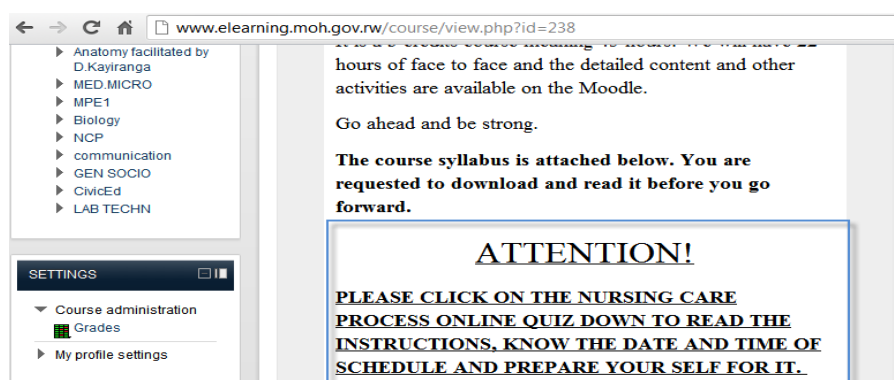
Figure 6: Screen shot of communication notice.

To ensure the quick response and tracking of tasks, the response – practice score 100% because the grades function as motivating factor to students, and they are the primary measure of success in a course. Tracking and calculating grades are serious and monotonous tasks.

Figure 7: grade items in the eLearning platform.

4.3.   Current eLearning status in HLIs in Rwanda

The population of students that uses eLearning is 4 % of the whale HLIs population this includes; certificate, diploma, degree and postgraduate. The table 4.5 below summaries the distribution of students in HLIs by study level according to the mode of study.

Table 4.5: Student population per Level and session studies in year 2012.

Level	Face to – face session		e-Learning Session		Total		
	M	**F**	**M**	**F**	**M**	**F**	**M+F**
Certificate	36	19	23	27	59	46	**105**
Diploma	6465	4738	1849	903	8314	5641	**13955**
Degree	32663	27305	94	78	32757	27383	**60140**
Post-graduate	1352	718	268	91	1620	809	**2429**
TOTAL	**40516**	**32780**	**2234**	**1099**	**42750**	**33879**	**76629**

Source: NCHE & NISR Higher Education census July 2012

Figure 8: *Percentage distribution of eLearning vs Face to face*
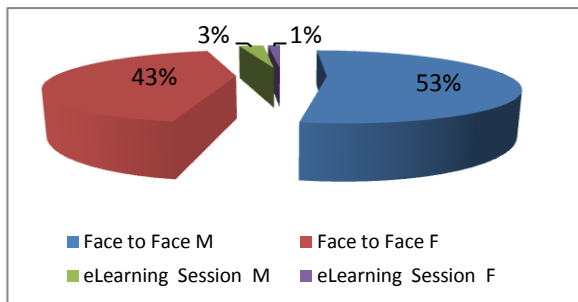
As illustrated 76,629 total students' population, about 4% of High Education student population uses eLearning. This is due to the fact that eLearning in Rwanda is not much adopted.

4.3.1. Is there a need to use virtual classrooms to supplement traditional classrooms in HLIs?

The demand for Higher Education in Rwanda is rapidly increasing (risen from 62,734 in 2010 to 73,674 in 2011) and is expected to rise even higher with the implementation of Twelve-Year Basic Education. There is also a need for more part-time, evening and weekend provision to allow potential mature students to return to study and/or update and up-skill themselves while maintaining their current level of involvement with employment or family. The current capacity of both public and private providers, though expanding, does not match the demand. The rapid expansion of demand for higher education is occurring at a time when the Government focus is on supporting basic education, including Technical and Vocational Education and Training in terms of infrastructure development, increased number of qualified teachers, etc. Although the Government will continue to support Higher Education, including the development of infrastructure, there is urgent need for innovative ways of funding Higher Education in general to match the researched growth.

One of the pillars of the strategies defined in Rwanda's Vision 2020 for increasing Rwandan human capacity is the creation of distance education and training programmes. At the 2009 National Leadership Retreat in Kivu, Open, Distance and e-Learning (ODeL) was discussed as a priority to meet the challenges of improving access, equity, and quality in education. A consultancy report and consultative meetings in 2010 reached a public-sector consensus that ODeL would be an effective way to achieve a massive expansion of higher education, given central support and facilitation.

As stated by Deputy Director General REB / ICT in Education and ODel Department, there several advantages of using ODeL to increase higher education opportunity in Rwanda by founding an Open University include:-

1. The possibility of rapidly doubling present capacity constraints and the percentage of

young people achieving higher education level qualifications (currently around 3%).

2. Open learning programmes would not only give higher education access to a wider cross-section of students; they are also very appropriate for professional development and up skilling and for the 'reclamation' of those who dropped out at an earlier attempt or did not have the confidence and the opportunity to try in the first place.

3. To provide a means of tackling widespread professional and technical skills shortages across the large majority of employment sectors,

4. Ensure fees for students are kept at a low level, addressing their limited ability to pay for conventional university study,

5. An open university can massively expand provision at a low unit cost to both Government as opposed to the high finances required for incremental growth of existing conventional Higher Learning Institutes,

4.3.2. Modes of delivery

The implementation of Rwanda Open University (ROU) as a new mode of education delivery in Rwanda requires analysis of educational media and technologies that will facilitate the achievement of its stated objectives.

1. Educational Media includes: generic forms of communication associated with particular ways of presenting knowledge

2. Education Technology includes: the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources. In this sense, traditional media such as: text, lectures, group discussions etc. still count as media.

4.3.3. National University of Rwanda portal

NUR is operating on e-learning using Moodle 2.2.1+ (Build: 20120112) with more than 950 users, the NUR is operating the blended learning since university is running face − to − face and it is using E-learning as added feature to support the learning.

4.3.3.1.   Analysis of usability of Moodle platform according to NUR Students.

Usability factors	Frequency	percentage
Efficiency	12	8%
Effect	4	3%
Helpfulness	3	2%
Control	4	3%
Learn ability	6	4%
Satisfaction	3	2%
Memo ability	6	4%

Justification of the response rate,

With a random sampling NUR, the existence of eLearning platform is not known, this has resulted into having low respondent to the survey. Respondents were 50 student in different levels, most of them argues that NUR have got there is a lot service that not well communicated to audience.

CIT centre in charge instruction technology states that the platform is operational it have more than 900 users, but when you count the course content per category is only 7%.

4.3.3.2.   Accessibility

The system is accessible in NUR network and even out of the network, every member of NUR have access on the Moodle, it authentication is from LDAP and every NUR staff or student have got the right to access the eLearning of NUR at elearn.nur.ac.rw even though it is available less than 7% percent of NUR community are consider to be the users of the eLearning.

4.3.3.3.   Explanation of the students' perception on interactivity of Moodle

Interactivity factor	Frequency	Percentage
Liner interaction (Listen)	0	0%
Liner interaction (Read)	12	24%
Response - practice with feedback	8	16%
Forum between Students	1	2%
Real time communication	1	2%

Justification

Students confirm that the Moodle platform can be very efficient in content delivery but has an inactive aspect to interactivity to interactivity of linear thus the platform offer purely linear interactivity which is text based. The Moodle platform score low 0 in linear interaction listen with no student giving it score in its capacity to facilitate them to listen. Even though these features are available in this platform, the students argue that it is because there are not motivated by their lecturers by putting the courses, on eLearning instead they share notes on their personal email.

The lecturer have access to the system more whereby the lecture Virtual Classroom, using multimedia technology the students can follow real-time class lecture by use of streaming technology. The staff are not use encourage to use the eLearning platform available in NUR, and even not informed to use the use of moodle , The WIZIQ Virtual Classroom plug-in for your Moodle website has just been updated to give you more control and an improved interface. The user interface of the module has been changed to match the look and feel of Moodle. The updated plug-in is compatible with versions from 2.0 to 2.3 of the open source LMS.[18] refer to figure 17 below the plug in are possible in the moodle platform.
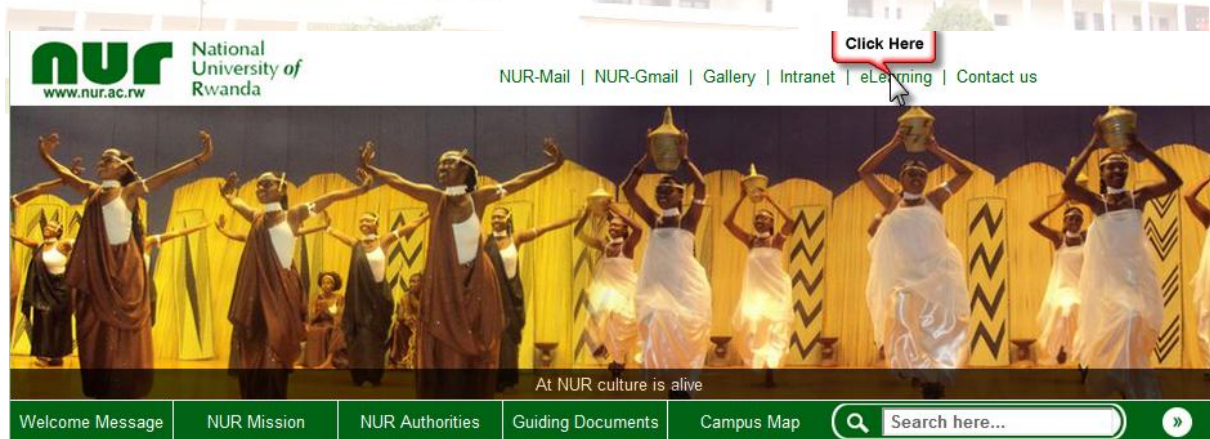
Figure 9: Screen shot of link of NUR eLearning portal

This was observed in NUR it is less than 7% of the NUR community who are aware of the platform. Most of students are not aware of the existing operations of the eLearning platform even if the link is on upfront page.
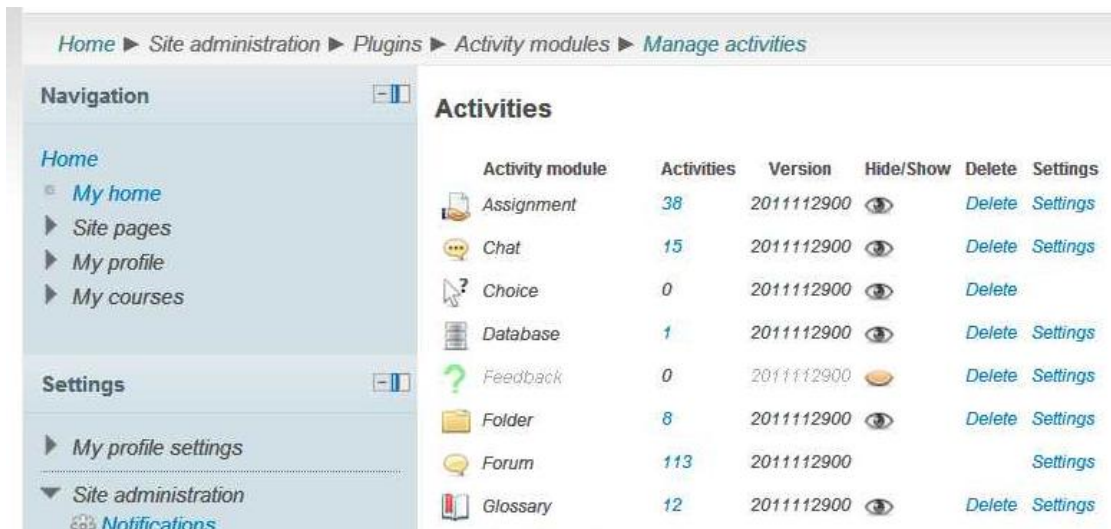
Figure 10: Screen shot of managing activities on NUR eLearning platform

Explanation;

The Site administrator manages the activities of the platform by ensuring the well operational of the platform and control of the visibility to end users. More modules that facilitate the correspondence with in there are maintained here on this option.
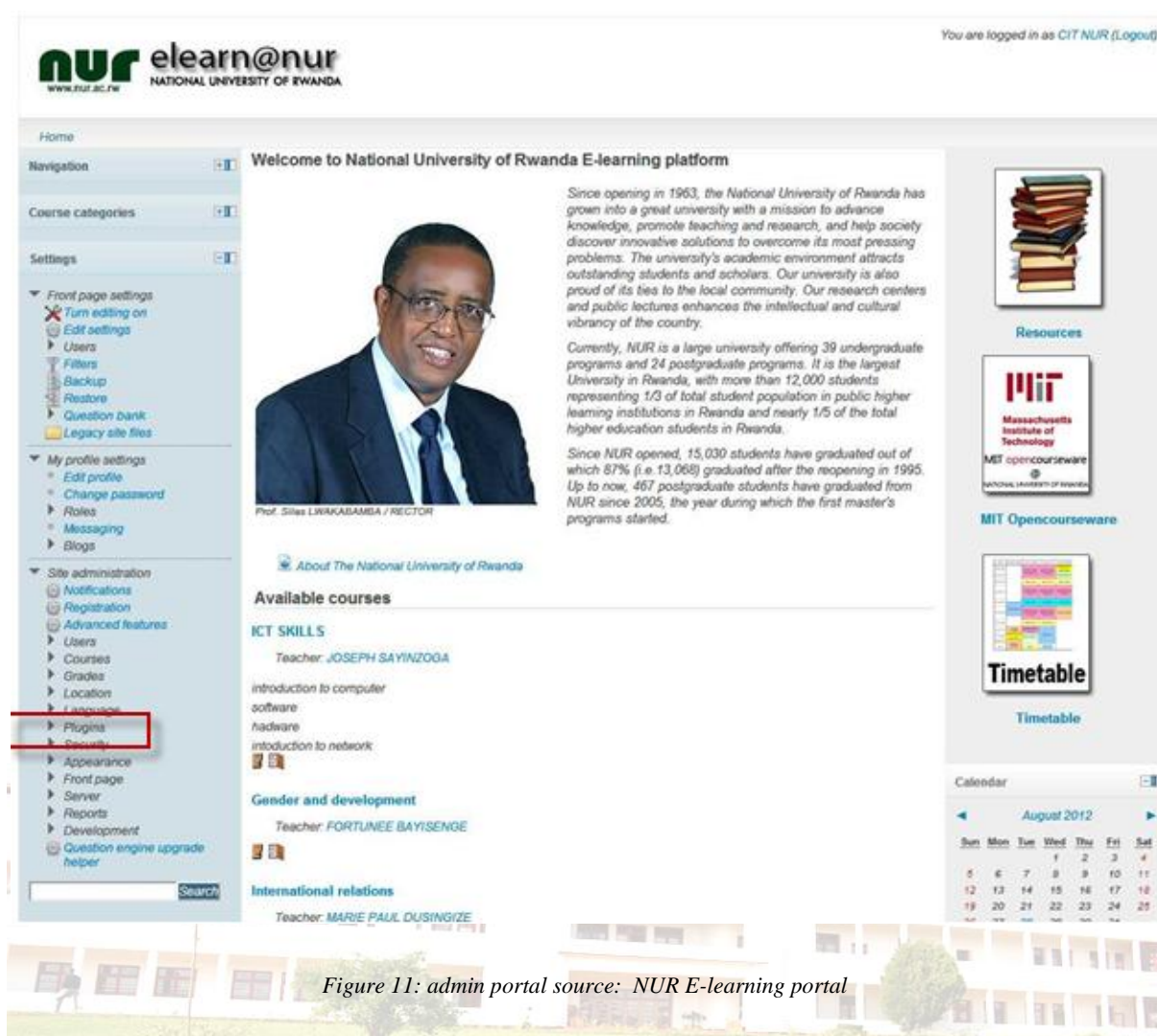
Figure 11: admin portal source: NUR E-learning portal

NUR portal is less similar to MoH, and it maintained by CIT / NUR. It is proved out that moodle is more used in many academic. On this admin portal it is possible to integrate the live class plug in for WIZIQ platform which supports live virtual class refer to figure 12 below. CIT staff state that moodle is well stable platform which can support virtual classroom in a good and live session.

The new roles and permissions system provides you with a huge amount of flexibility to manage how students and other users interact.

Figure 12 screen capture of WIZIQ plug-in live class

Figure 13: User permission screen print source NUR E-learning portal

More other feature are available such as statistics; If you enable site statistics, Moodle will gather statistics about each course and for the whole site and produce graphs displaying them.

4.3.4. Kigali Institute of Education virtual classroom

This section summarises the findings from Kigali Institute of Education (KIE) is in partnerships in implementation of Tele-Education of the Pan-African e-Network Project, they have hosted about 281 post-graduate students since 26 February 2009. By academic year 2011, the KIE was started to offer masters 9 postgraduate programs online.

4.3.5. Mode delivery

KIE runs real time session in collaboration with Pan-African under e-Network project; they are running real time systems (Synchronous Learning). The figures 12 & 13 below that illustrate the architecture of the network.
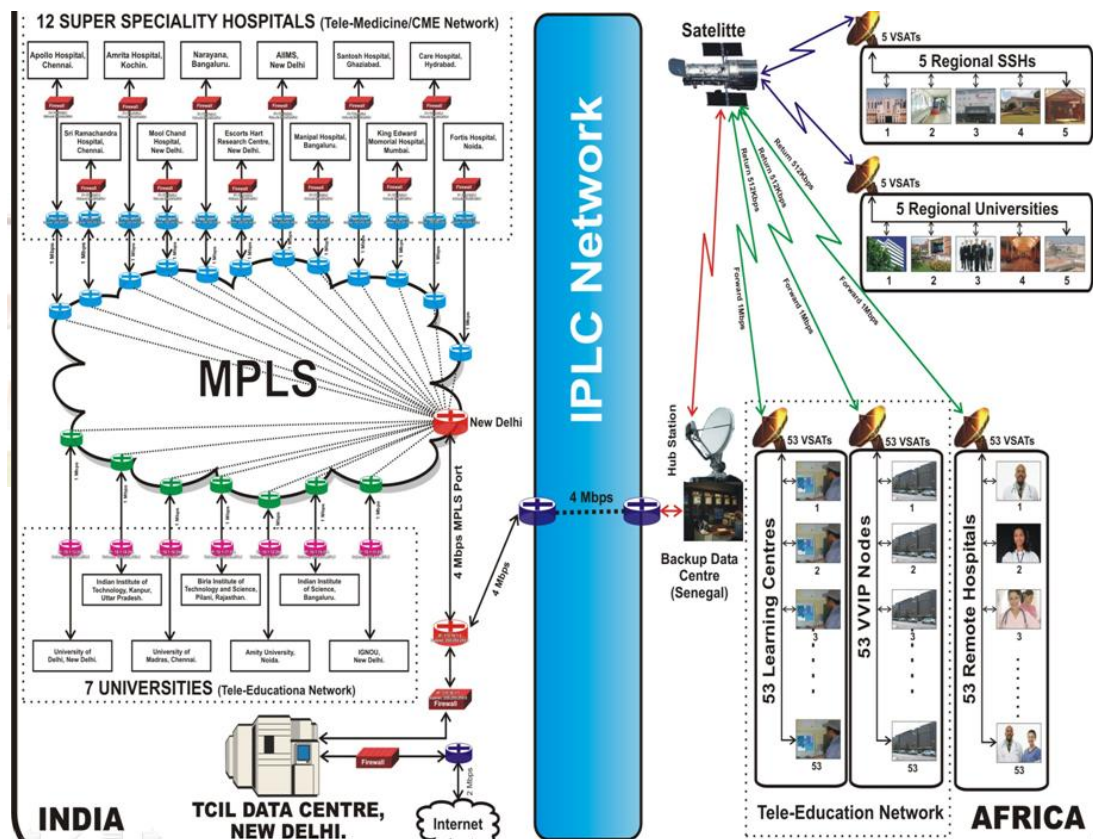
Figure 14: Network architecture E-Network

Figure 15: Pan African E-network: Tele – Education Services

4.3.6. Interactivity of Tele education,

Taking in consideration on the other institutions we have found out that KIE is running virtual classroom under Pan African e-Network. It is fully Synchronous Learning, student and technical staff testify that the platform is very effective and interactive enough, according to the architecture, the enrolled student attends a lecturer from KIE premises known as faculty studio, and there are facilitated by the studio admin.

4.3.7. Data Base accessibility and security of eLearning platform

The students access the database using their user names created at faculty by faculty studio admin and the can access the platform via HTTPS which encrypts the user's login data, so it's difficult to sniff out a user's username and password on the network.

The students are able to ask question and interact direct with the lecturer who is in multimedia studio.

Figure 16: Synchronous Learning, source; Pan African E-network: Tele – Education Services

Studio Administration is composed of three main components; University Admin who duty is to creation, approval and studio session schedule, the Studio Admin is an agent of faculty, s/he registers, approval registration and carry out session allotment, Studio Faculty the venue that facilitates student to view session, conduct the live session, and it is appropriate venue for knowledge management, all these are established at KIE.

4.3.8. Licensing and systems ownership

The Virtual University portal is hosted by Pan African E-Network in collaboration with Indian Universities, and Regional centre – RC and Learning centre and Students. This is joint initiative with the African Union that program is running.

4.4.   The ICT Infrastructures in Rwanda

In this research the bandwidth utilization and availability of facilities to support virtual class in Rwanda was a key research question. It was stated by RDB IT that ICT facilities currently we have are covering all Districts of Rwanda and National Fibre-optic Backbone and Business Development Centres (Tele Centres) is widely spread over in the country. The National Backbone Network (NBN) is a high speed 2,300 km fibre network that connects districts and border posts within the country the backbone network was completed on the 31st of December 2010 and is connected to all 30 Business Development Centres (tele-centres)

Business Development Centres (Tele centres)

12 have 15 computers and are build in containers, 18 have 42 computers and are located in a big room; however we suggest that the Business Development Centres are not reliable because their primary duties are the business development services; in addition they have numerous activities listed as follows :

Figure 17: Tele Centres

1.   Business Development

2.   IT Short term Training

3.   Community Internet Surf

Figure 18: Map of Broadband Network covering all districts. Source: RDB/IT

4.4.1. Computer availability in HLIs

The number of computers in HLIs, which belongs to students, Academic staff & Administrative staff, are 6258, 825 and 1080 respectively. Among them, personnel computers which have access to Internet are 5444, 769 &1018.

4.4.2. Infrastructures located in Teacher Training Colleges

All Teacher Training Colleges (TTCs) and Rukara College of Education are connected and has Computers that are on average 50 Computers per TTC. However the internet is slow and this infrastructure is actively used by the host institution and might not be reliable. And among the beneficial of National Fibre – optic backbone NUR is benefiting the bandwidth of more than 80 mps, see the figure 19 below;

4.4.3. Infrastructure support at NUR

NUR Internet connectivity had improved both on in terms of bandwidth and number of ports. The ports have increase from 1920 (2010) to 2736 (2012) figure below illustrated the increase of bandwidth,

Internet bandwidth at NUR

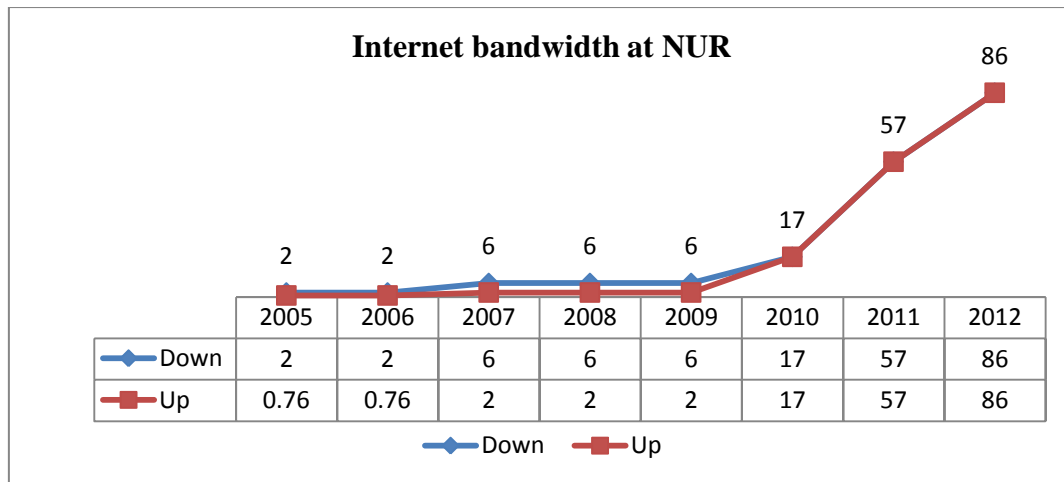|	2005	2006	2007	2008	2009	2010	2011	2012
Down	2	2	6	6	6	17	57	86
Up	0.76	0.76	2	2	2	17	57	86

Figure 19: ICT centre presentation on the increment of Bandwidth

Improving the bandwidth in NUR has lead to increase to usage electronic learning resources said by Director of ICT. The utilization on e-learning resources at NUR has been increasing from 2009 as per figure below. The usage on e-learning in 2009 & 2010 it was the second cited in NUR learning resources after MIT Open Courseware (OCW), in 2011 it have increased the index but still second after e-journeys.

	Ebooks	eJournals	eLearning	OCW
2009	-	-	2,886	14,479
2010	805	55	30,259	89,312
2011	972	2,137	20,689	32,788
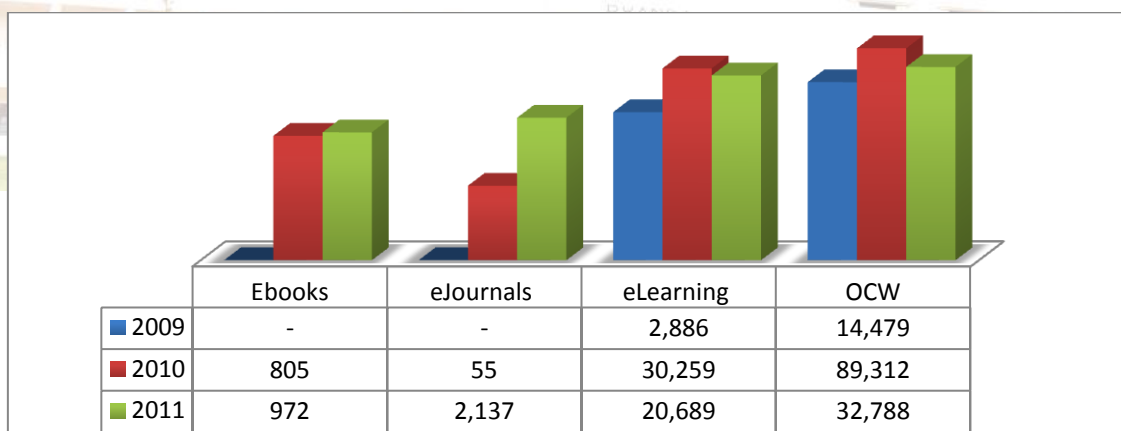
Figure 20: Electronic Services usage at NUR (2009 – 2011)

This counts the number of hits per year, where more effort is still needed in order to improve awareness.

4.4.4. Data Base accessibility and security of Moodle platform

Since there are web based the database are all accessible under the user access, on the web portal. For security HTTPS encrypts the user's login data, so it's difficult to sniff out a user's username and password on the network. HTTPS is enabler on server before you for every web server has a different method for enabling HTTPS.

Chapter 5: Conclusion and Recommendations

The eLearning platform development should to be treated as a software development, the needs of the users have to addressed and by putting into consideration functional requirement and systems requirements. This means the developers have to think "out of the box" and develop the platform with a clear policy that enforces the operations of the systems.

5.1. Conclusion

In order to find out which platform can be used we have conducted a comparative study about the two platforms. From this research of the respondents' perception of the eLearning platforms and observation with regard to the existing infrastructure, virtual classroom in Rwanda is feasible. The comparison criteria were mainly the platform functionalities and related pedagogical added value, cost and support. Moodle is most commonly used and it meets almost 80% of need to the users, and it accommodates numerous plug-in.

The existing infrastructure of NBN which covers all districts and offers high speed internet to all regions of Rwanda a web based platform can serve better, the web based is preferred because it does not require addition client setting to access the platform.

5.2. Recommendation

The eLearning platform that is to be developed using non licences platforms that allows the users to own the source code of the application, it was mentioned by respondents that moodle is more operational and interactive enough to support the virtual class room, this has been proved by research that moodle accepts the plug-in that can facilitated the virtual live class using WIZIQ. The openness of moodle provides not only cost effective advantage but also the space for more innovative ideas form the world wide community. This is an added advantage for Moodle because Blackboard is a commercial platform with licensing fees. Other on-line tools essential to support open learning and its administration are Digital library, Plagiarism detection systems, online journals, online repositories Survey system, Mail system and Student Information System (SIS) and Management Information System

(MIS) most of the systems are available, the need is to find further how to interoperability of these systems. A requirement analysis should be done before the development eLearning platforms and further maintenance plan should be developed.

5.2.1. Addressing the usability

These aspects greatly rely on the eLearning developers. From the analysis of the usability perceptions of the users it is evident that users have not been factored in the development. There is a limitation that users have got the system without pre-selection study and analysis in order to be user's requirement driven, and users are not well informed about the platform.

To encourage the lecturer of NUR that in the use of eLearning is for the general benefit of this investment for the use of this platform.

5.2.2. Suitability

It was proved out that Moodle is suitable eLearning framework that is support eLearning in Rwanda compared to black board and Tele- Education which are licensed in terms of cost and interoperability the preference is on moodle.
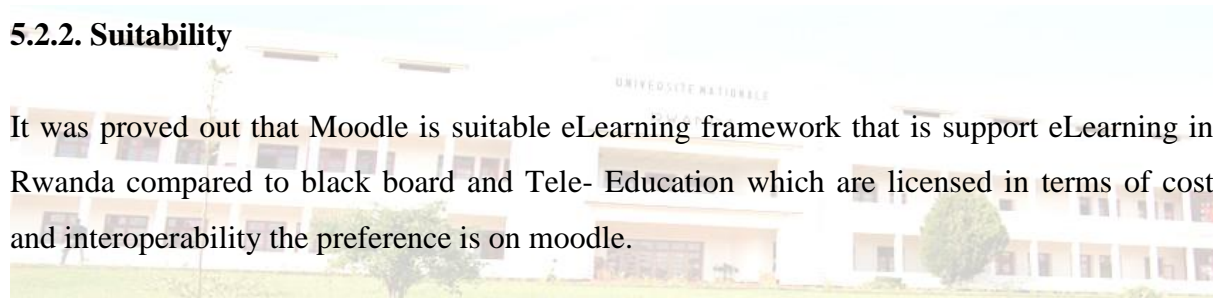
Asynchronous learning components exist on this framework, and this will increase linear interactivity of listening between the lecturer and the students. This will help when the student want to have one to one engagement with their lecturer.

The bandwidth is no longer a challenge in Rwanda, according to RDB − IT and BSC the National Backbone Network supplies to all districts in Rwanda and capacity of National Data centre, the existing bandwidth can serve the Education sector and e-learning platform can be hosted as SaaS. [19]

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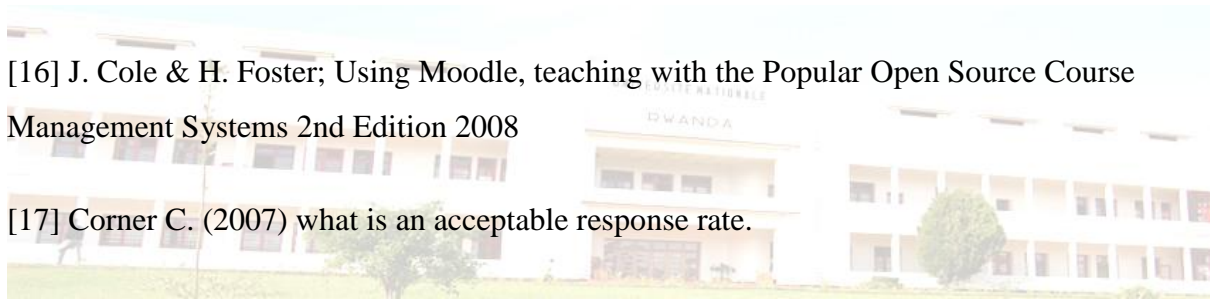[15] Inception report from the Taskforce on the Rwandan Open University REB

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Appendices

A. Interview Guide

i. **What uses of virtual classrooms with optimised bandwidth utilization are feasible as an option in Rwanda? (BSC)**

    a. What is the current internet coverage in Rwanda and status of the bandwidth that is can possible be used internal in Country?

    b. What type of transmission media that are highly used in Rwanda and the capacity of technical support for data warehouse in country?.

    c. Is possible to run SAAS or IAAS in Rwandan Network that can serve education and community?

ii. **What are possibilities of using virtual classrooms to supplement traditional classrooms in Higher Learning Institutions (HLIs)?**

    (MoH and REB{KIE, KHI, NUR})
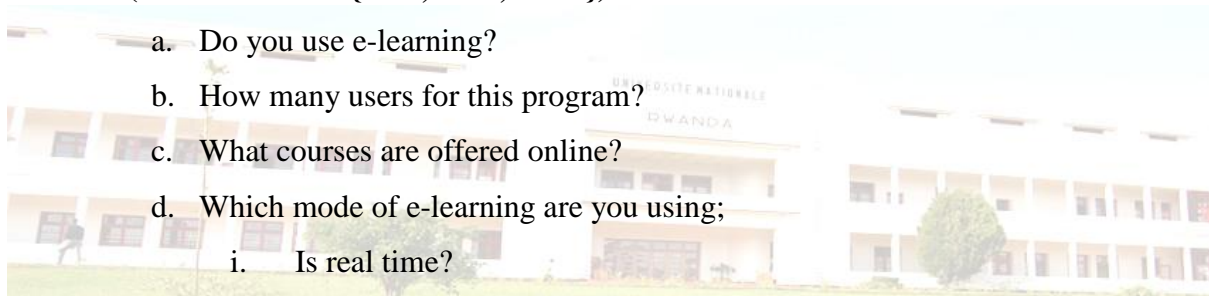
    a. Do you use e-learning?

    b. How many users for this program?

    c. What courses are offered online?

    d. Which mode of e-learning are you using;

        i. Is real time?

        ii. Asynchronous approach?

    e. Who and How do you put the content online?

    f. Are the lectures trained on the use of e-learning platform?

        Yes   No

        If yes for how long;

iii. **Which is the most suitable framework for supporting eLearning services?(MoH IT department, KHI – IT department, REB- IT department, NUR – CIT unit, KIE – IT Department)**

    a. What could be the characteristics of a good platform of e-learning you would prefer to have?

    b. What could be the basic feature could that platform must have?

B. Research questionnaire

This questionnaire is for my academic research work and your assistance will be highly appreciated. The purpose of the questionnaire is to determine the usability of virtual class as an added platform in HLIs in Rwanda. For each and every information you give on this research will be solely for academic purpose.

Thank you for your participation

BEN RUHINDA

NATIONAL UNIVERSITY OF RWANDA (Masters Project)

General Information

1. Please give the following information by ticking in the appropriate box and filling in the provided space

    Institution Name: ………………..

    Level of Studies: ………………

    Gender: Male   Female

Usability and Interactivity of eLearning platform

2. How often do you use the eLearning system in your course work?
    Frequently   Rarely   Not at all

(i)   If frequently do you find the eLearning system easy to use?
             Yes   No

(ii)   Do you find the eLearning system interactive in :
    a) Reading the notes presentations sent by the lecturer

    Yes   No

    ……………………………………………………………………………………
    ……………………………………………

b) listening to class sessions

Yes   No

If no why?

………………………………………………………………………………………
    …………………………………………

c) Watching class sessions through videos and animations

Yes   No

If no why?

…………………………………………………………………………………………
    …………………………………………

d) Practicing on topics taught and getting feedback to get more understand

Yes   No

If no why?

…………………………………………………………………………………………
    …………………………………………

e) Communication between you and the lecturer

Yes   No

If no why?

…………………………………………………………………………………………

f) Communication between you and other students (forums)

Yes   No
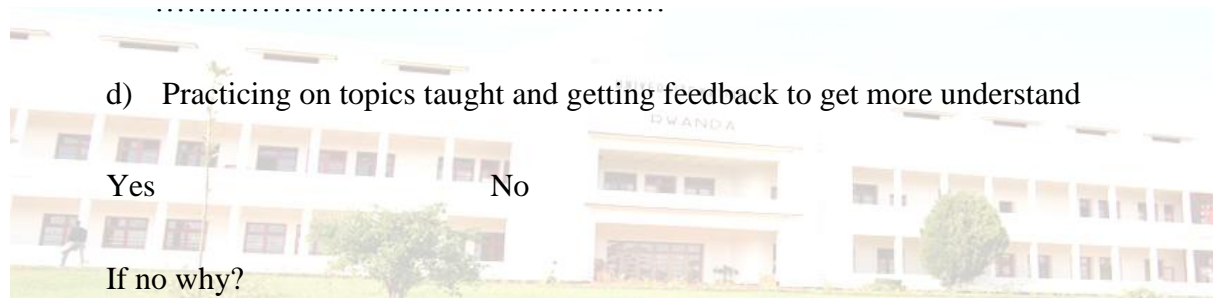
If no why?

…………………………………………………………………………………………………

g) Offering games that you can interact with to increase retention level of a certain topic

Yes   No

(iii)   In offering exploring activities that encourage your participation?

Yes   No

If no why?:

…………………………………………………………………………………………………

(iv)   Do you find the eLearning system reliable?

Yes   No

If no why?:

…………………………………………………………………………………………………

………………………………………………………

(v)   Do you find eLearning system efficient (quick and economical)?

Yes   No

If   no   why?:

………………………………………………………………………………………………

(vi)   Do you find the eLearning system efficient in content delivery?

Yes   No

If   no   why?:

…………………………………………………………………………………………………

(vii)   Does the eLearning system stimulating and pleasant?

Yes   No

If   no   why?:

…………………………………………………………………………………………………

(viii)   Does the eLearning system offer help on how to use it(help menu)?

Yes   No

If   no   why?:
………………………………………………………………………………………

(ix)   Does the eLearning respond in a normal and consistent way?

Yes   No

How easy is it to accomplish task by use of the eLearning system?

(Please give a brief description)
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………

(x)   Do you think the eLearning system organizational structure helpful?

Yes   No

If no what recommendation would you give for the improvement of the eLearning system organization structure?

………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………