

RESEARCH PAPER

**AN EFFECTIVE KNOWLEDGE MANAGEMENT OF GRADUATE RESEARCH OUTPUT AT KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY**

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**ABSTRACT**

*This study investigates and explores avenue for effectively managing and increasing the availability of Graduate Students' scholarship by submitting Theses and Dissertations in electronic format for easy accessibility and storage. This pilot study was done in the year 2009 with Graduate Students in the Faculties of Fine and Industrial Art in the Kwame Nkrumah University of Science and Technology (KNUST). Qualitative research was employed to appraise and analyse Theses and Dissertations (TDs) management in the School of Graduate Studies (SGS) and the University Library. In addition, graduate students' knowledge of online publishing and the capabilities of the Network Operations Centre (NOC) of the KNUST in managing the Electronic Theses and Dissertations (ETDs) were reviewed. An online framework resource was designed and developed to manage and promulgate graduate research output in the structure of ETDs. This framework named "KNUSTVester" is founded on the philosophy of Open Access (OA) Initiative and mimicked the submission processes of the SGS and employed the Dublin Core Metadata Element Set (DCMES) for accessing the ETDs online. Testing of the online framework resource was done and the results confirmed that the submission of theses and dissertations electronically could be an effective tool for the promulgation of knowledge and skills in this 21<sup>st</sup> Century.*

**Keywords:** *Online publishing, theses and dissertations, knowledge workers, management, electronic publishing*

**INTRODUCTION**

It is an indubitable fact that scholarship is what thrusts national development. In this information era where knowledge sharing has become paramount, added value is placed on graduate scholarly research; consequently, the awareness of increasing scholarship beyond the customary academic environments has become the new order.

In making graduate scholarly research accessi-

ble there is the need to re-evaluate the related interest in scholarly communication and publishing; especially making scholarship cost effective in the limelight of advancing technology. Accordingly, this study explores an electronic system for the management and promulgation of graduate Theses and Dissertations (TDs).

Electronic Theses and Dissertations (ETDs) are a new genre of documents, continuously re-

defined, as technology and student's knowledge evolve (Fox, 2001). Mao (2003) opines that ETDs are an electronic version of printed TDs. They are getting more and more popular in universities, as ETD systems could save shelf space, be more easily searched and retrieved online, and be able to store multimedia data. Lowry (2006) states that a fundamental goal of libraries and universities in establishing digital repositories is to make them more easily accessible. He further says that if we restrict the access to ETDs, they become gray literature, inaccessible and fundamentally invisible to the scholarly record.

Sometimes librarians are able to assist researchers in their hunt for elusive data collections; but, in the absence of consistent mechanisms for collection, preservation, curation, and dissemination of research data, there is no expectation of consistent results, so future researchers are not well served. Nicholson and Bennett (2011) indicate that while informal paths to data access and data sharing may serve some members of a research community, it seems that maintaining such a haphazard and idiosyncratic system of data sharing, especially when better methods are available, is contradictory to fundamental principles of scholarly practices supported by sound and consistent methodologies.

As cited by Vijayakumar *et al.* (2006), the Robert Gordon University ETD site states that ETD can take a variety of forms, from a Word or PDF version of a printed thesis, to a truly digital publication that includes audio and visual material and may be organized quite differently from a printed thesis. The benefits of ETDs include the reduction in the needless repetition of investigations that are carried out already, the ability to add richer and more expressive contents, and building of students' career. In fact, ETDs allow more adventurous students to express their research results in creative and flexible ways that would not be possible if they were limited to paper based output. 'Born digital' theses may include audio

and visual material and may not even be in a traditional linear format (Vijayakumar *et al.*, 2005).

Adobe Systems Incorporated (2008), emphasizes that electronic theses and dissertations (ETD) can easily be distributed via the Internet, electronic catalogs, and other means of digital communication. With ETDs you can expand the reach of your document and ease its distribution across the world. Statistics from Virginia Polytechnic and State University (Virginia Tech.) in the USA reveal a very high level of use of electronic theses and dissertations (ETDs) that are available on the Web as the server log reveal an access of 24,934,678 in the 2006/2007 fiscal year. An analysis of the accesses from US domains reveals that use of these theses is not limited to educational establishments; over the past few years government, commercial and other miscellaneous organisations have consulted the works. In the 1990s, Virginia Tech. was one of the first institutions to encourage the creation of ETDs. Since then, the ETD movement has flourished internationally, and membership of the 'Networked Digital Library of Theses and Dissertations' (NDLTD), which was initiated in 1997, has increased significantly (Copeland and Penman, 2004).

Since the inception of the School of Graduate Studies in Kwame Nkrumah University of Science and Technology (KNUST), over thousand scholarly works relevant to academia, both national and international, have been produced. In the era of advancing Institutional Repository (IR) technology, bound copies of TDs are still submitted to the Graduate School. These scholarly research outputs get stacked on library shelves, most of which remain lost or inaccessible to researchers who are expected to make use of the outcome of these research works.

This article aims at addressing the problem of storing graduate research output by bringing together ideologies of stakeholders who are dedicated to exploring new technologies for im-

proving value of scholarship. It also addresses the use of online infrastructure and knowledge management strategies to improve scholarly quality and public accessibility. Finally, it seeks the coherence of this body of knowledge in a sustainable and globally accepted form. This is accomplished through the design and development of a content management to manage the digital asset.

### MATERIALS AND METHODS

The study employed qualitative method of research. Since qualitative methods are descriptive in nature the purpose of descriptive survey employed in this research revolved around two diverse categories of survey which resulted in first, the appraisal of the following:

- a. Submission, storage and accessibility of graduate theses.
- b. Graduate Students' knowledge of Information and Communication Technology, specifically, in online publishing which involves the use of the computer and the internet.
- c. Network infrastructure and how effective it can sustain digital knowledge management.

The second facet of the survey is on responses and comments to ascertain the efficiency and effectiveness of the designed digital framework in managing the ETDs.

#### Data collection instruments

**Questionnaire:** The study employed questionnaire which decisively dealt with responses to questions related to the respondents' abilities to use the internet as online tools and their general comments on the submission and access processes of the ETDs.

**Interview:** An interview was used to solicit information from the School of Graduate Studies, the Main Library, and the Network Operations Centre – all at KNUST – prior to the design and development of the Virtual Reality (VR) simulation and the ETD-Content Management System (CMS). Most of the concepts

gathered from the interviews were used as the basis for the design and development processes. In addition, a cross section of graduate students within Faculties of Fine and Industrial Art was interviewed. This was to find out their experiences and perceptions about the ETD-CMS and what might have directly influenced their decisions.

### APPRAISAL OF MANAGEMENT OF TDs AND NETWORKING SYSTEMS WITHIN KNUST

#### 1. School of Graduate Studies (SGS)

##### *Strength in managing Theses and Dissertation*

- a. **Database:** The School of Graduate Studies keeps a comprehensive database on all its activities, principally, by keeping records of Theses and Dissertations that have been submitted and those that are yet to be submitted.

##### *Weaknesses in managing Theses and Dissertations*

- a. **Lack of storage facilities:** The SGS does not have adequate facilities to store submitted TDs. There are no room spaces and shelf spaces to store the TDs.
- b. **Misplacement of TDs:** There are no traces of some TDs submitted to the SGS. Most of the TDs are lost through pilfering, and some of them grow mouldy. Occasionally, lecturers go to the SGS to request for TDs but some fail to return them.

#### 2. The KNUST Library

##### *Strengths of the University Library system*

- a. **Standard classification scheme:** The library uses the Library of Congress Classification scheme for classifying its information materials which include thesis, journals, books and technical reports.
- b. **External links to online repositories:** The main library has been able to extend the services of other online repositories to the KNUST community to boost their col

lections. These repositories include JSTOR, Agora, and DOAJ. They distribute online journals in both general and specialized fields of study. These services are usually offered at the electronic information section. Currently, anybody connected to the KNUST-net can fully access these online journals. The repositories also give opportunity to members of the KNUST community to tender in soft copies of articles for peer reviewing and publication (Library Guide, 2008).

#### *Weaknesses of the University Library system*

- a. **Underprivileged security strategies:** At the thesis section there was no security presence, therefore, the section was left at the mercy of the attendants of the section. This might give students who use the facility the opportunity to remove pages of some TDs.
- b. **Inadequate storage facilities:** There were inadequate shelves for storing publications. As the years go by, the shelves get filled up leaving no space for shelving submitted TDs. This gave the section no option than to pack some of the TDs on the floor.
- c. **Difficulty in locating a thesis:** Locating a particular thesis on the shelves at the thesis section was complicated and painstaking. This might deter graduate students from visiting the section for research.

### **3. The Graduate Students**

#### *Strength of Graduate Students in ICT*

##### **Appreciable level of ICT literacy:**

- a. Graduate students in the study area exhibited fundamental skills and competencies in the use of computer and the internet. The students also had fair knowledge in, at least, a word processing and a PDF application software. These imply that students' knowledge in ICT was progressively mounting. Eighty one (81) graduate students responded to a set of questionnaire. The responses received show that 52

(64.2%) respondents rated their knowledge in ICT as very good, 21 (25.9%) rated good and 8 (9.9%) rated average with none responding as a poor user of the internet.

#### *Weaknesses of Graduate Students in ICT*

##### a. **Students inability to create PDF file**

Though some graduate students had fair idea about PDF applications, some of them could not create PDF file. Therefore, some training in this area is recommended.

##### b. **Shortfall of internet access to students living outside campus:**

Most of the students live outside campus and do not have personal internet connections. This means graduate students residing outside campus will largely depend on the internet rather than the local area network. Forty-one (50.6%) respondents were discovered to possess their personal internet connectivity as against 40 (49.4%) respondents relying on other internet connectivity.

##### c. **Students' inability to publish online:**

Graduate Students were not trained as knowledge workers and therefore not motivated to publish electronically.

### **4. Network Operations Centre (NOC)**

#### *Strengths of the KNUST-net*

- a. **Well trained technical staff:** Staff at both the NOC and the ICT Centre are recruited based on their specific areas of expertise. Highly qualified staff such as CISCO certified engineers through to system analysts were employed to work at these centres. Also, national service personnel are recruited on interim basis to beef up the work force at the centre. They are usually selected from the Departments of Computer Science, Computer Engineering, Electrical Engineering, Communication Design and Social Sciences.

#### **State-of-the-art Information Technology equipment:**

- b. The NOC had installed modern equipment to boost their services to

the KNUST community. Though minimal, the experts at the NOC were able to manage the traffic both at peak and recession times. The ICT Centre had also been stocked with an additional 200 desktop computers to effectively offer ICT training to administrative staff and students.

- c. **Well structured ICT courses:** The ICT Centre organizes a number of highly specialized courses for undergraduate and graduate students. The courses range from basic introduction to desktop computer to advanced courses such as A+ certification, CISCO networking and web design. Most of these courses are offered during vacation with the exception of introduction to desktop computer.
- d. **Network accessibility:** The NOC has been able to extend the network services to almost all departments on campus. Though some departments are not connected to LAN the NOC extends WLAN services to them. The ICT Centre also provides LAN services as well as laptop connectivity and wireless internet access to lecturers, administrative staff and students as well.

**Weakness of the KNUST-net**

**Low speed of transmission or bandwidth:** With the users of the KNUST-net increasing, there is always the problem of low transmission especially at the peak time. This problem is also attributable to the fact that C band VSAT technology is out-dated. In addition, all the departments are linked from switch to switch which slow down the rate of data transfer.

**DESIGN AND DEVELOPMENT OF THE CONTENT MANAGEMENT SYSTEM (CMS) :** Considering the strengths and weaknesses of the TD management and the networking system in KNUST, it became relevant to propose an alternative device of TD management named “KNUSTVester”. Vester was derived from the Open Archive Initiative Protocol

for Metadata Harvesting (OAI-PMH) as the system harvests Metadata of related ETDs.

The design and development of the ETD-CMS involved multifaceted logic and decision making. A comprehensive plan was developed to guarantee that strict procedures were followed in order to achieve well structured productivity and goal set. The plan covered an approximated period of five months which started from 1<sup>st</sup> September 2008 through to 28<sup>th</sup> February 2009.

In developing computer applications a common practice is to write independent components that work in multiple “tier” or layers. One of the most popular approaches is a three-tier application (Bradley *et al.*, 2003). Based on this assumption the development plan was divided into three tiers namely the presentation tier, the business tier and the data tier. Each of the functions of the multitier application is meant to be coded as a separate component and in a manner that can be stored and run on different computers.

**Device and application software used for the design and development**

Appropriate hardware and application software were employed for the design and development of the ETD-CMS. The hardware device includes Dell Vostro 200 desktop computers which were used as a platform for the artwork, and as a local server for pre-testing the applications. The application software employed was divided into two categories namely: Front-end applications (for client-side programming) and Back-end server applications (for server-side programming). The former refers to the applications used for building the clients’ Graphic Users Interface as well as the programming logic, and it includes applications such as Adobe Photoshop CS3, Adobe Flex builder 3.0, Adobe Integrated Runtime (AIR), Adobe Flex component explorer 3.0 beta (online resource) and Adobe Flex style explorer 3.0 beta (online resource). The back-end application refers to applications that were used for developing the database and it incorporates applications such

resource). The backend refers to applications that were used for developing the database and it incorporates applications such as apache, MySQL, SQLyog and PHP.

### Content of the ETD-CMS

Research in the area of user interface design for computer-based learning environments found that screen and interface design should be considered at the same time during the design and development process (Jones *et al.*, 1995). The ETD-CMS was designed as two different applications but deliver the same content. The applications included a desktop application (Rich Internet Application) that operates on AIR and the web application. The intent for the development of the ETD-CMS as a desktop application is to handle the bandwidth issues, deploy the ETD-CMS as a browser-less application and a cross-platform runtime environment. The content of the ETD-CMS includes the following:

**The Home Page:** The Home page contains hyperlinks (links) that lead clients to the other component of the applications. It also includes features that provide information from the database such as “ETD top 10 list” and “ETD news” (Fig. 1).

**The Registration Component:** The registration component represents the section where a client is given the chance to register the needed details into the database (fig.2).

**The Login page component:** The login component is designed to assist the client in submitting an ETD. In accessing the database, the component provides two text fields which allow clients to enter their usernames and passwords to validate and authenticate the submission process (Fig. 3).

**The Filter component:** The filter component aids the client to search the content of the database for available ETDs. The component is presented as an entry form with interactive buttons and text field for basic and advanced filtering. The basic filter gives the client an opportunity to enter into the text field, a search item (full title or keyword in the title) which returns all items that match the search. The advanced filter gives the client the chance to look for a specific item or items by entering the title, the author and/or keyword in the ETD. The advance filter, moreover, allows the client to specify a search criteria based on a given period, that is, between specified years or the last time a client

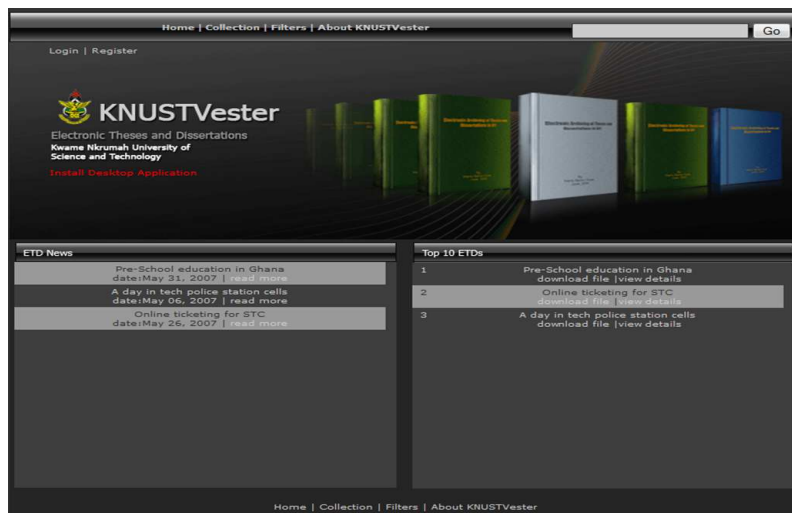
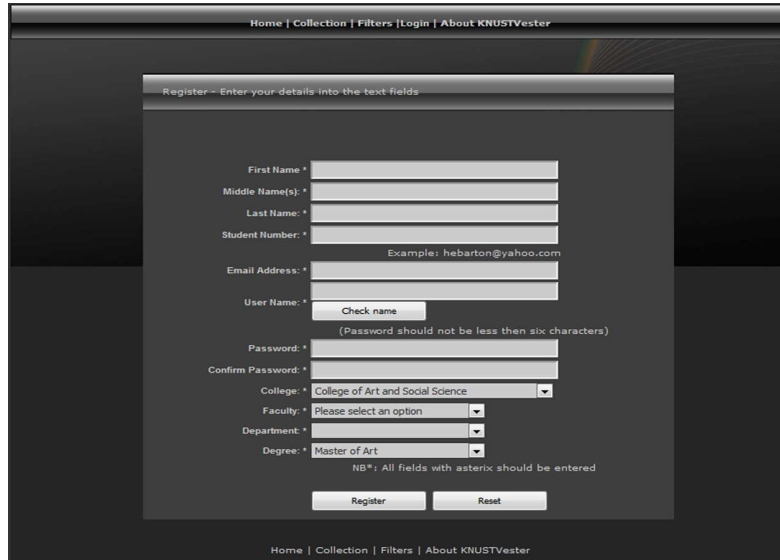


Fig. 1: Home page component

performed a search (Fig. 4).

**The Collection page component:** The collection component, like the filter component, searches the database for available ETDs that

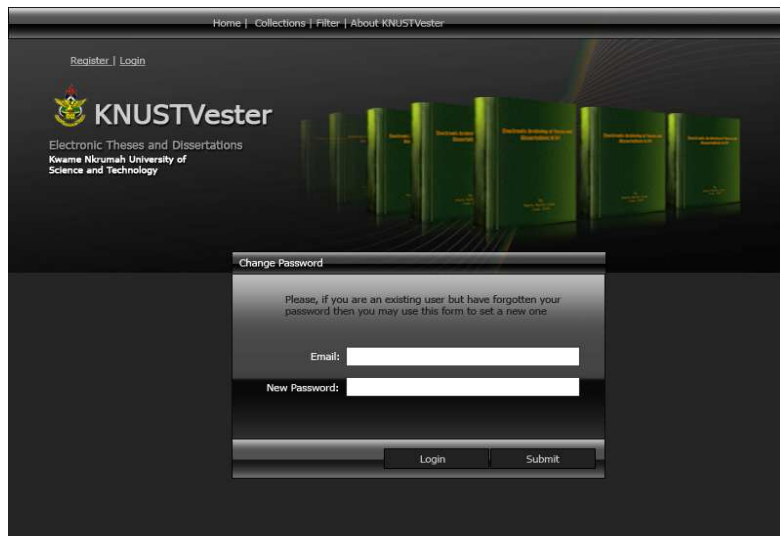


The registration form is titled "Register - Enter your details into the text fields". It includes the following fields and controls:

- First Name \*
- Middle Name(s) \*
- Last Name \*
- Student Number \*
- Email Address: \* (with example: hebarton@yahoo.com)
- User Name: \* (with a "Check name" button and a note: "(Password should not be less than six characters)")
- Password: \*
- Confirm Password: \*
- College: \* (dropdown menu showing "College of Art and Social Science")
- Faculty: \* (dropdown menu showing "Please select an option")
- Department: \*
- Degree: \* (dropdown menu showing "Master of Art")

A note at the bottom of the form states: "NB\*: All fields with asterisk should be entered". There are "Register" and "Reset" buttons at the bottom of the form area.

Fig. 2: Registration component



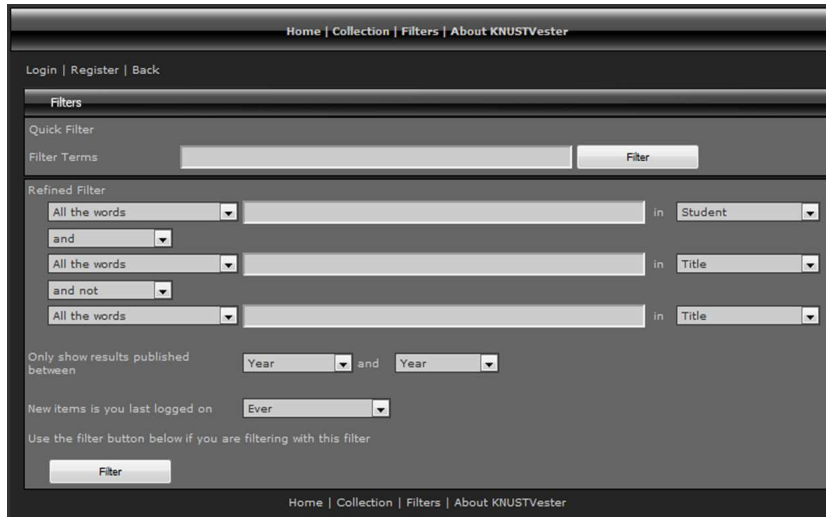
The login component is titled "Change Password" and includes the following elements:

- Navigation links: Home | Collections | Filter | About KNUSTVester
- Links: Register | Login
- KNUSTVester logo and text: "Electronic Theses and Dissertations, Kwame Nkrumah University of Science and Technology"
- Background image of several green book covers.
- Text: "Please, if you are an existing user but have forgotten your password then you may use this form to set a new one"
- Fields: Email: and New Password: (both with input boxes)
- Buttons: Login and Submit

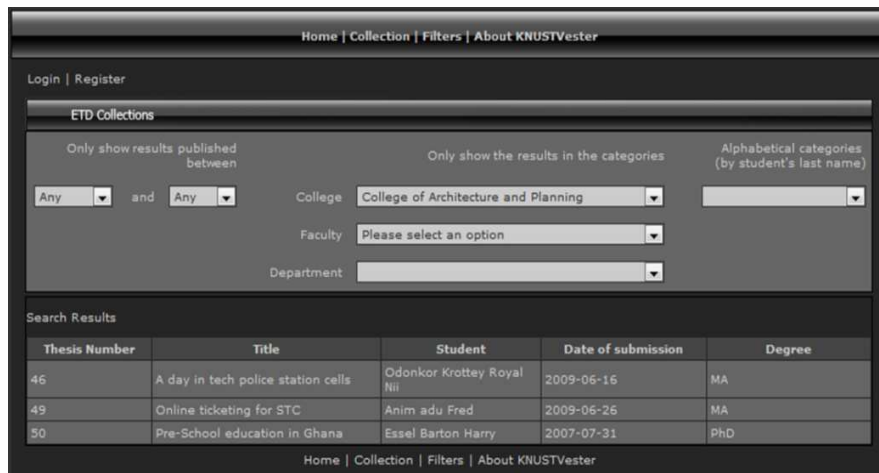
Fig. 3: Login component

have been submitted. The distinction between the two components is that the collection component presents all the ETDs while the filter presents ETDs based on the client's request (Fig. 5).

est to begin by conceptualizing how the familiar paper-based processes would be replicated in the online environment. This is besides an occasion to put into operation efficiencies and streamline document processing (McMillan,



**Fig. 4: Filter page component**



**Fig. 5: Collection page component**

**The logical workflow of the ETD-CMS:** When starting an ETD initiative it may be easier to begin by conceptualizing how the familiar paper-based processes would be replicated in the online environment. This is besides an occasion to put into operation efficiencies and streamline document processing (McMillan, 2002). The logical workflow describes the sequential processes involved in the ETD-CMS



(Fig. 6). The key stakeholders involved in the workflow are the graduate students, lecturers (supervisors and Heads of Department) and the ETD-CMS administrator. Graduate students who want to be part of the system would have to go through these logical procedures. Lecturers on the other hand are registered into the system by the administrator.

Upon launching either the desktop or the web applications, what the Graduate student encounters first of all, is the home page. The first step is to register to be part of the system by clicking the register link. The registration page opens with a form where the Graduate student is expected to enter his/her details, and then clicks the register button. If the registration is successful the system prompts with a message. After the registration, the Graduate student is expected to login with his/her user name and password on the login page.

If the login is not successful, the system prompts with a message; if successful, the system advances the graduate student to login details page where information about the ETD to be submitted is entered including the selection of supervisors. Provisions are also made for the client to upload the ETD and other supplementary files in PDF. When the upload button is clicked the system registers the ETD with a unique thesis number and forwards the information to the supervisors' inbox and then prompts the graduate student with a message.

The supervisors log in to receive the details of the submitted ETD in their respective inbox provided within the system. They scrutinize the ETD for authentication. If not satisfied a message is sent to the graduate student. If satisfied, the ETD is approved and a confirmation message is sent to the graduate student. In situations where there are mandatory two supervisors, all of them have to approve the ETD for the next logical step to commence.

The Heads of Department (HODs) are the last in command to approve the ETDs after an in-

box confirmation has been received from the supervisors. The ETD goes online for public viewing after it has been approved by the respective HODs.

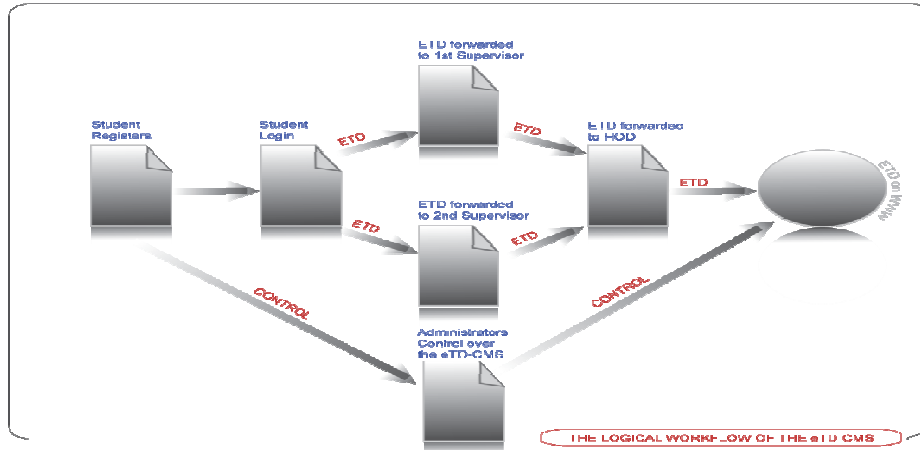
## **RESULTS AND DISCUSSION**

### **a. Graduate Students who accessed the front-end applications**

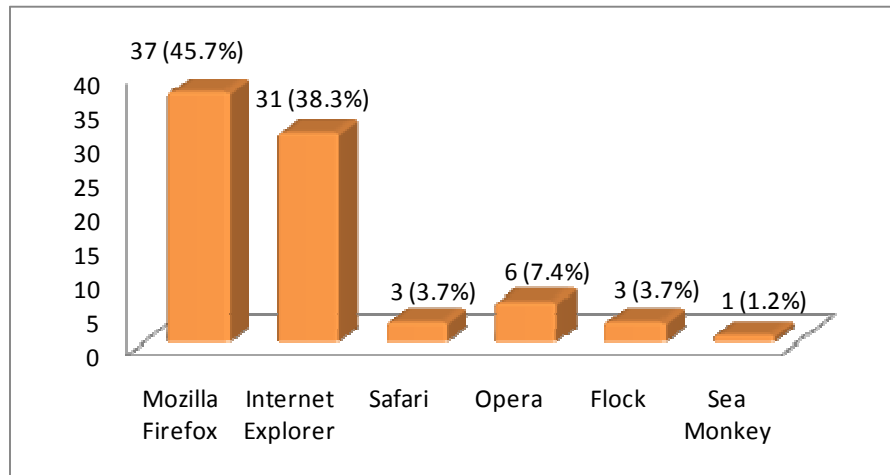
The ease with which respondents accessed the desktop and the web applications was paramount. This aspect concentrated on accessibility in terms of identifiable operating system platforms, browsers and network services. Three operating systems stood out as the most used among the respondents. These include Microsoft Windows, Macintosh and Linux operating systems which were used to install and run the desktop application. According to responses gathered, 69(85.2%) respondents accessed the desktop application on Microsoft windows while 11(13.6%) and 1(1.2%) accessed the application on Macintosh and Linux respectively. There were no errors reported with any of the operating systems identified as respondents attempted to access and install the desktop application. This confirms and signifies the fact that the desktop application is capable of virtually running as a cross-platform application.

According to the responses obtained, six different browsers were used to access the web application. These include Mozilla Firefox 37% (45.7%), internet Explorer (IE) 31 (38.3%), Safari 3 (3.7%), Opera 6 (7.4%), Flock 3 (3.7%) and Sea Monkey 1(1.2%). (Fig.7).

From the statistics, it was realized that Mozilla Firefox and IE enjoyed the highest patronage from the respondents. It was also realized that most respondents who accessed the web application with Firefox and IE were Microsoft windows users. According to the respondents, Firefox and IE have more add-on features and most often are pre-installed software that accompany the operating system. None of the respondents reported any error using the afore-mentioned web browsers except those who used low ver-



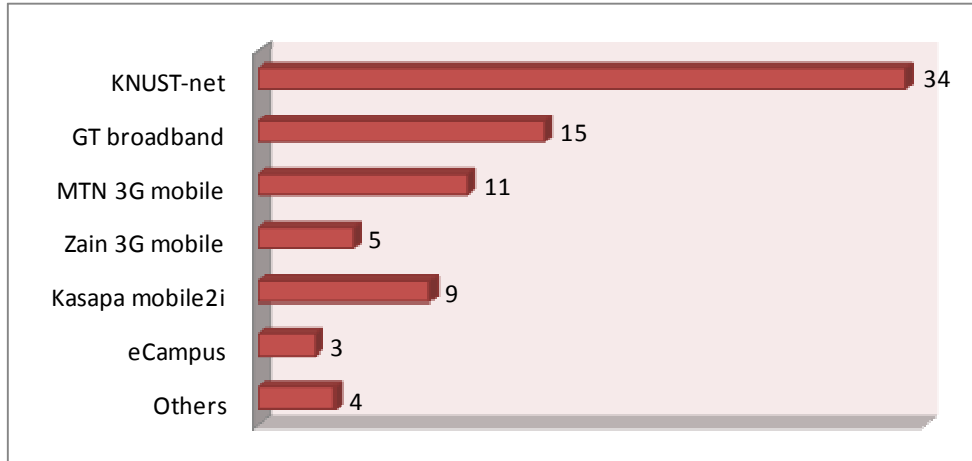
**Fig. 6: Logical workflow of the ETDCMS**



**Fig. 7: Browsers used by respondents**

sions of IE (version 5 or lower). From the errors reported, IE (version 5 or lower) had problems interpreting the Cascading Style Sheet syntax which either distorted the layout or prevented some controls from populating. Although lower versions of IE posed some chal-

lenges, it can still be justified that web application has cross-browser compatibility features. This is because most clients of IE use either version 7 or 8 which is free from such anomalies and can best display the web application. Different networks were used by respondents to



**Fig. 8: Different networks used by respondents**

access the ETD-CMS applications. Among the identified networks were KNUST-net, GT Broadband, MTN 3G network, Zain 3G mobile network, Kasapa mobile 2i, eCampus wireless and other networks (Fig. 8). The KNUST-net was the predominantly used network among the graduate students.

According to the respondents, acquiring a private internet service involves relatively huge cost; hence, they preferred using the KNUST-net which is virtually free. The respondents who encountered setbacks with the applications' accessibilities were mainly users of the KNUST-net. It was discovered that each user of the KNUST-net receives an average rate of 9kbps which sometimes fluctuates. The main issues reported include the inability of respondents to access the web application initially at a faster rate. This generated runtime errors which prevented some of the respondents from accessing the desktop application online. The gathered responses consequently suggest that the ETD-CMS is capable of running on all networks though bandwidth problems were initially encountered by respondents who used the

KNUST-net.

**b. Graduate Students who experienced the submission process for ETD-CMS**

Respondents were required to experience the registration and the submission process in order to appreciate the effectiveness of the applications. After thoroughly examining the applications, the responses reflected an affirmation that the registration and the submission modus operandi in the online environment are easy and convenient.

The respondents asserted that the digital environment presents a simple procedure for submitting an ETD as compared to the conventional system of submitting TDs. Others responded that the step-by-step tutorial, which is part of the applications, facilitates the comprehension of the registration and submission processes. The ETD-CMS submission procedure, according to the respondents who had prior knowledge of digital libraries, is comparatively simpler as many content management systems have complex submission structures. Generally, it is deduced from the pre-test that

graduate students should be able to register and submit an ETD without much problems.

**c. Graduate Students' experience with the retrieval process of the ETD-CMS**

Being able to conveniently search for the contents of the ETD-CMS was also tested. This was to ascertain whether students would be able to easily retrieve query item with the filter (quick and advanced) and the collections search systems. Seventy - eight (96.3%) respondents commented that the search criteria were comprehensive and appropriate while 3 (3.7%) commented otherwise. Most of the respondents who commented positively on the search criteria were those who had prior experiences with digital library technology. Their reasons were that the options presented with the search criteria were novel and in-depth, and user queries were with precision. Conversely, respondents who declined revealed that they were comfortable with the quick filter and the collections search criteria. They added that the advanced filter had options and conditions which were somewhat intricate to comprehend.

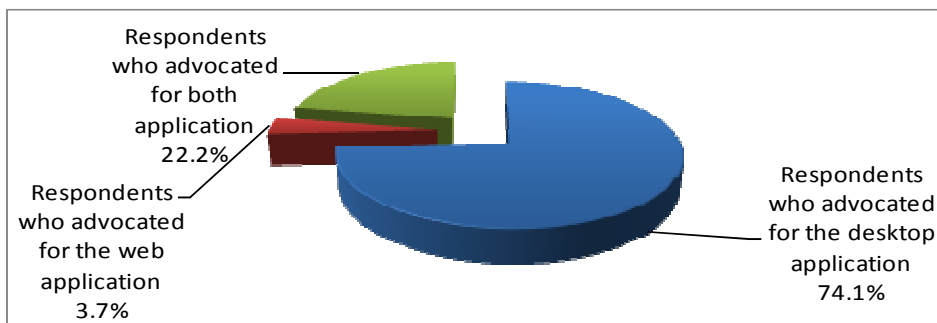
**d. Comments received after Graduate Students thoroughly experienced the ETD-CMS procedures**

Responses received revealed that 60 (74.1%) respondents advocated for the desktop application while 3 (3.7%) responded positively for the web application. Eighteen (22.2%) respondents also advocated for both applications (Fig. 9).

According to the respondents, they preferred the desktop application because it responds faster to user clicks when registering or submitting an ETD or filtering the content of the ETD -CMS. It was also realized that the respondents who preferred the desktop application were users of the KNUST-net. The possible reason to this may be the fact that initialization of the web application will be sluggish on networks with low bandwidth since graphics and data are transferred together. Respondents who used high speed networks recommended both applications as exchange of data is relatively faster. The web application was mainly recommended by respondents who could not install and run the desktop application since they did not have AIR on their system.

In comparing the ETD-CMS with the University Library (specifically TDs management sections), 66 (81.5%) respondents said if the ETD-CMS are managed effectively, it can be a total replacement of the library's conventional method while 15 (18.5%) thought otherwise. Comments from those who responded otherwise assumed the institution was not ready to manage library resources digitally considering the perennial network problems and power outages that predominantly occur on KNUST campus.

Other comments from the respondents also revealed that the ETD-CMS is user friendly as it is easy to understand and employ, and is also accessible on most devices including mobile



**Fig. 9 : Respondents' advocacy for the applications**

devices. Respondents also commented on the aesthetics of the user interface and the constructiveness of the applications' architecture in terms of submission, storage and access. The negative comments revealed that respondents were not pleased with the fact that the desktop application has a fixed window which denies users from maximizing the application to a full screen view; and, also AIR had to be downloaded and installed before running the desktop application. The respondents rated the usefulness of the ETD-CMS after they had passed their comments.

### CONCLUSION

The ETD-CMS worked exactly as what the researchers expected and planned. It is built on the conventional TDs submission to the School of Graduate Studies and the cataloguing processes adopted by the University Library of KNUST, though the TDs submission and cataloguing processes have been modified to enhance online indexing and searching. These modifications are in compliance with the Open Archive Initiative and Open Access making the content of ETD-CMS universally accessible. "Open Access to literature means it is free and available on the public internet and it permits users to read, download, copy, distribute, print, search or link to the full text of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal or technical barriers other than those inseparable from gaining access to the internet itself" (Budapest Open Access Initiative, 2010). An important factor in the research project seems to be minimalism. Learning a clear-cut conversion from a word-processed document to PDF and submitting for approval through online or web form has proven very successful after the ETD-CMS has been designed, developed, deployed and tested with graduate students for a month.

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