

**The Challenges of E-learning in Architectural Education:  
A Case study of the Federal University of Technology, Yola, Nigeria.**

**By**

**Professor Olu Ola Ogunsote**

**Department of Architecture, School of Environmental Technology**

**Federal University of Technology, Akure**

**and**

**Joel Oladipo Omofaye**

**Director, Computer Resource Centre**

**Federal University of Technology, Akure**

**and**

**Dr. (Mrs.) Bogda Prucnal-Ogunsote**

**Department of Architecture, School of Environmental Technology**

**Federal University of Technology, Akure**

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# **The Challenges of E-learning in Architectural Education: A Case study of the Federal University of Technology, Yola, Nigeria.**

Olu Ola Ogunsote, Joel Oladipo Omofaye and Bogda Prucnal-Ogunsote

## **Abstract**

*The Department of Architecture of the Federal University of Technology, Yola, Nigeria is located in a remote part of Nigeria which has hampered the synergy of using resource persons from other architecture schools and from practice. The advances in Internet technology have however made possible e-learning and instant communication with resource persons, thus making physical remoteness irrelevant. The challenges of reliable infrastructure, adequate computer hardware and software, bandwidth management for audio and graphic data transfer and security however remain very real. This paper discusses the establishment of a direct satellite link with the Department for e-learning and communication. The topics covered include power infrastructure, hardware and software. The software installed is for Internet browsing, email, instant messaging, audio-visual communication and remote access. Document viewers, media players and CAD and graphics software were also installed. The local database contains e-books and e-magazines apart from a library of 3D models, drawings and photographs. The use of special data formats for speedy access to remote data is discussed. Implementations of e-learning systems are discussed including the OpenCourseWare by the Massachusetts Institute of Technology (MIT), Cambridge, USA and the e-learning project by the National Universities Commission (NUC), Abuja. It is concluded that e-learning in architectural education is feasible within the current infrastructural, financial and technological constraints.*

Keywords: *architectural education, e-learning, ICT, Nigeria, Yola.*

## **1. Introduction**

This paper discusses the establishment of a direct satellite link for e-learning and communication with the Department of Architecture of the Federal University of Technology, Yola (FUTY) which is located in a remote part of Nigeria with poor access roads and over four hundred kilometres from the nearest School of Architecture. The remoteness of the school has hampered the synergy of using resource persons from other architecture schools and from practice, but the advances in Internet technology have made possible e-learning and instant communication with resource persons, thus making physical remoteness irrelevant. The major challenges are those of reliable power infrastructure, adequate computer hardware and software, bandwidth management for audio and graphic data transfer and security. This paper discusses the hardware, software, libraries and databases used for the project. Other topics discussed include alternate virtual personalities, special data formats and implementations of e-learning systems.

## **2. Problem definition**

Communication with the Federal University of Technology, Yola is hampered by several factors.

### **2.1 Remoteness**

Yola is the capital of Adamawa State. Located just inside the border with Cameroun, it is several hundred kilometres from the economic and administrative power houses of the nation, Lagos and Abuja. With poor access roads which many consider unsafe and few commercial flights, it takes two days to get to Yola from Lagos by road. It is 436 kilometres from the nearest School of Architecture in Bauchi. The location of the University about twenty kilometres outside town in a low density area also reduces the commercial viability of communication infrastructure.

### **2.2 Limited Internet Connectivity**

Like with other Federal Universities of Technology, Internet connectivity, though vigorously pursued, is still limited. Currently, only the Library and the Computer Centre are connected directly to the Internet. While the current speed of the connection may be adequate for Internet browsing, adding several users concurrently downloading large volumes of audio-visual data will certainly slow down the system.

### **2.3 Bandwidth Limitations for Transfer of Graphic Data and Audio-Visual Communication**

The transfer of large volumes of graphic data and real-time audio-visual communication requires a very fast connection to increase upload and download speed and reduce delays in audio communication and flickering in video communication. Broadband access is imperative for efficient delivery of online architectural learning and teaching.

### **2.4 Unreliable Power and Communication Infrastructure**

As with other parts of Nigeria, electric power supply in Yola is unstable while coverage by the Global System for Mobile (GSM) communication is limited.

## **3. The Strategy for Efficient E-learning**

The strategy for creating and sustaining an efficient communication link for e-learning with the Department has several components including establishment of direct satellite-based Internet connectivity using a Very Small Aperture Terminal (VSAT), installation of adequate Internet communication hardware, installation of Internet, communication and remote access software, procurement of multi-media equipment and training.

### **3.1 Establishment of Direct Satellite-Based Internet Connectivity Using a VSAT**

The establishment of direct broadband Internet connectivity to the Department using a Very Small Aperture Terminal (VSAT) is crucial to the success of the project. Using a shared connection with other departments will result in contention for bandwidth and users transferring large volumes of data will be more adversely affected.

### **3.2 Reliable Power Infrastructure**

The key issue in Nigeria as at the time of this research is the unreliability of electric power supply from the mains. Provision of alternative power should be made to guarantee usage at any time. Provision of an adequately big generator and adequate budget for fuel to guarantee its planned use is essential. In addition, stabilizers, inverters and Uninterruptible Power Supplies (UPS) should be used to ameliorate the unreliable power infrastructure. Investment in solar power solutions is worthwhile especially for power-critical devices and computer systems that must be up and running almost all the time. The power infrastructure needs to be more reliable to reduce interruption of file transfer.

### **3.3 Installation of Adequate Computer Hardware**

The computers currently connected to the Internet in the University are optimised for Internet browsing and office computing. More powerful computers with extra graphics capabilities may be required for audio-visual communication and CAD. Special accessories and larger storage space are also needed.

### **3.4 Installation of Computer Software**

The installation of appropriate and current Internet, communication and remote access software is essential for communication and e-learning, especially because such software is not commonly installed on public-access computers. While *Internet Explorer* can be found on most computers, there is need to install other Internet browsers, instant messaging software, audio-visual messaging software, Email software, VoIP software and remote access software. Installation of CAD and graphics software is also essential.

### **3.5 Procurement of Multi-media Equipment**

While individuals can conveniently work with a Personal Computer for e-learning, the simultaneous display of media content to groups and classes is best done using digital projectors for projecting the monitor onto a screen. Another, though more expensive approach is to use very wide screen LCD monitors. The advantage of the wide screen LCD monitors is that they are also used as touch screens. Lectures and demonstrations can also be recorded on CDs (700MB) or DVDs (4.7 or 8.4GB) and then played back using VCD/DVD players or DVD decoders. Such media content can also be maintained in the local database. New innovations that enhance e-

learning include the Interactive Whiteboard Solution which allows the recording or transfer of notes and drawings on the whiteboard directly onto the computer, handheld PDAs or PocketPCs. This content can also be broadcast in real-time over the Internet.

### **3.6 Training and Maintenance**

The use of a computer for e-learning in a standalone installation is bedevilled by many problems. A reliable and efficient system depends on most of the components working properly most of the time, and the link can easily be broken due to power, hardware or software problems. On the positive side however, the most significant component which is the VSAT link is 99.9% reliable. Also, highly reliable power, hardware and software systems are available. The key to maintaining an uninterrupted link is however proper training of users and regular maintenance by skilled engineers.

## **4. The Computer Hardware**

The hardware consists of a VSAT and accessories, power conditioning equipment, router, switch, server (gateway), computers and miscellaneous accessories including headset, USB web camera, USB external disk drive and flash drives (Ogunsote, 2001a).

### **4.1 VSAT Setup**

The Very Small Aperture Terminal (VSAT) hardware comprises of a 1.2m Channel Master dish (Plate 1), a HN7000S satellite terminal (modem), a 2W BUC, cables and connectors.

### **4.2 Power Conditioning**

Stabilisers, inverters and Uninterruptible Power Supplies (UPS) are used to ameliorate the unreliable power infrastructure. The modem and server are connected to a 1.2KVA UPS which in turn is connected to an inverter. Power stabilization is achieved by a 5KVA stabilizer. A standby generator is provided.

### **4.3 Routing and Wireless Connectivity**

The modem is connected to a 16-port D-Link switch. A Linksys Wireless-G broadband router model WRT54GL (Plate 2) is connected to the switch to provide controlled access to the Internet, especially for wireless connectivity.

### **4.4 Networking**

The router provides wireless networking and at the same time allows connection to the wired network. The wired network links a few computers, but all computers in the Department will eventually be on the *Local Area Network* (LAN) when computerization of the Department is complete. The computers currently on the wired network are in the Departmental Office, the Departmental Library, the Computer Room and a staff office. Some staff also connect wirelessly.

### **4.5 Gateway**

The gateway is a Pentium IV computer with 512MB RAM and a large (80GB) primary hard disk (Plate 3). A second hard disk (300GB) will be installed as the system expands. The gateway



Plate1: Location of the Very Small Aperture Terminal (VSAT).



Plate 2: Linksys Wireless Router

has a double layer capable DVD+RW drive which makes it possible to store up to 8.7GB of data on a single disk. Installation of a broadband bandwidth manager as part of the network gateway system would prove helpful in the management of the available bandwidth if it becomes financially difficult to embark on provision of sufficient bandwidth for Internet access to all users.

#### 4.6 Computers

The computers are Pentium IV and Celeron computers with 512MB RAM and 80GB hard disks. The computers have the latest versions of CAD and graphics software installed apart from audio-visual communication and remote access software.

#### 4.7 Mobile Computing

There is need to give special consideration to mobile computing which is a recent development in networking and a significant contributor to the efficient delivery of e-learning materials. With laptops, palmtops and notebook computers becoming common, students and teachers should have seamless access to the Internet and e-learning resources on the departmental Intranet wherever they may be on the campus. A wireless base station with omni-directional spread of network signal would provide sufficient coverage for network access on the go.



Plate 3: Modem, gateway and wireless router.

#### 4.8 Miscellaneous Accessories

Other accessories provided include headphones for audio communication, USB web camera for video communication and flash drives for physical transfer of data outside the network. The USB external disk drive is used for storing large volumes of data and can be used to transfer large files outside the network.

### 5. Software for Audio-Visual Communication and Remote Access

The software installed for communication and remote access include Internet browsers, instant messaging software, email software, audio-visual communication software and remote access software (Table 1).

#### 5.1 Internet Browsers

The preferred Internet browser is *Microsoft Internet Explorer*. Also installed is the popular and fast Internet browser *Opera*. Other popular Internet browsers include *Firefox* by the *Mozilla* Project and *Netscape*.

#### 5.2 Email Client Software

The attraction of email was one of the most significant factors responsible for the explosion of the Internet. The ability to send mail across the world as easily as across the



Plate 4: Microsoft Outlook contacts.

Table 1: Software for audio-visual communication and remote access

Category	Recommended Software
Internet Browsers	Firefox, *Microsoft Internet Explorer, Netscape, Opera.
Email Client Software	AIM Mail, Eudora, FastMail, Gmail, Hotmail, Microsoft Outlook, Microsoft Outlook Express, Thunderbird, *Yahoo! Mail.
Instant Messaging Software	ICQ, Skype, *Windows Live Messenger, *Yahoo! Messenger with Voice.
Audio Visual Messaging Software	Opera, SightSpeed, *Skype, Windows Live Messenger, *Yahoo Messenger with Voice.
Remote Access and Desktop Control Software	GoToMyPC, *Hamachi, LogMeln, Microsoft Remote Assistance, NetViewer, pcAnywhere, *RealVNC.
Document and Graphics Viewers	*Adobe Reader, Adobe Acrobat, DWF viewer, Microsoft Windows Picture and Fax Viewer, Zinio Reader.
Media Players and DVD Software	Nero Premium, QuickTime, Windows Media Player.

Source: Field studies. The \* represents most popular software.

room is still the reason a large majority of people uses the Internet today. There are numerous free email services including *Gmail* by *Google*, *FastMail*, *Yahoo! Mail* (Plate 5), *AIM Mail* by *America on Line* (AOL) and the *Microsoft Network* (MSN) *Hotmail*. These free services offer plenty of storage, effective spam filtering, a fast interface and desktop email program access (email.about.com, 2006).

Email clients are used to access several email accounts (usually Post Office Protocol, POP accounts) from the desktop without logging in individually to these accounts. The email client can be used for organizing the mail and contacts into virtual folders, searching and spam filtering. Additionally, messages can be stored offline, so that users can review or reply to messages without being currently connected to the Internet (www.oucs.ox.ac.uk/email, 2006). The most popular email clients include Eudora, Microsoft Outlook (Plate 4), Microsoft Outlook Express and Thunderbird from the Mozilla Project.

### 5.3 Instant Messaging Software

Instant messaging software is used for direct communication. The most popular include *Yahoo! Messenger with Voice*, *Skype* (Plate 6) and *Windows Live Messenger*. *Opera* also has a private chat feature. To use any of these services, the user must register using a valid email address, although many of these services are free. The software enables the instant exchange of text messages between any two registered users using the *Chat* feature. *Conferencing* allows many users to inter-



Plate 5: Yahoo! Mail client.



Plate 6: Skype contacts.

communicate instantly. *Chat Rooms* are platforms for hundreds of general and special interest topics. A user joining a chat room is connected in conference mode with other users in the chat room. Other very useful features include file transfer by dragging files into the *Instant Messaging (IM)* window and sharing of photographs. The use of message archiving, stealth settings and user profiles improves record keeping and customisation. *Skype* also supports the *Short Messaging Service (SMS)* for sending text to mobile phones anywhere in the world for a small fee (*Plate 8*). Free SMS services are limited to a few countries.

#### 5.4 Audio Visual Messaging Software

The *Voice over Internet Protocol (VoIP)* is the technology used to transmit voice conversations over a data network using the Internet Protocol (IP). Such data network may be the Internet or a corporate Intranet (www.shiftnetworks.com, 2006). The most popular software for free video calling includes *Yahoo Messenger with Voice (Plate 7)*, *Skype*, *SightSpeed* and *Windows Live Messenger* (Janowski, 2006). The easiest to install and use and the best video quality is found in *SightSpeed*, but *Skype* has millions of registered users, and is the most popular free VoIP service. There is usually a small delay in transmission of video, but video quality can be improved by reducing image size. Commercial VoIP services include *Vonage*, *Skype (Plate 10)*, *Cisco CallManager* and recently *Yahoo! Voice PhoneOut*. These services allow users to call practically any telephone line in the world from a computer. These services sometimes allow you to have a telephone number assigned to you, such that calls made to the assigned number are directed to your Internet computer connection.



Plate 7: Yahoo! Messenger with Voice main screen.

#### 5.5 Remote Access and Desktop Control Software

Remote access to computers over a *Wide Area Network (WAN)* or the Internet usually requires a *Virtual Private Network (VPN)*. Setting up an IPsec VPN is the most common means of providing remote access to corporate applications and resources (Jang, 2003). For infrequent remote access to applications and data however, a software VPN may be the best solution (*Plate 9*). These applications allow file transfer, remote



Plate 8: Skype SMS.



Plate 9: Virtual Private Network (VPN).

Table 2: Document and Graphics Viewers

Viewer	Document type
Adobe Reader	PDF files, digital books, digital magazines
Adobe Acrobat (Acrobat Distiller)	PDF files, digital books, digital magazines
Microsoft Windows Picture and Fax Viewer	Graphics files (JPEG, TIFF, BMP, etc)
DWF Viewer	AutoCAD DWF files
Zinio Reader	Digital Magazines and e-books.

Source: Field studies.

assistance and remote desktop control. They include *GoToMyPC*, *Hamachi*, *LogMeIn*, *Microsoft Remote Assistance*, *NetViewer*, *pcAnywhere* and *RealVNC* (Plates 11 and 12).

### 5.6 Document and Graphics Viewers

While *Windows Explorer* can display thumbnails of most media files, document viewers are required to view and review media documents. Document and graphics viewers include *Adobe Reader*, *Adobe Acrobat*, *Zinio Reader* (Plates 13 and 14) and *Microsoft Windows Picture and Fax*



Plate 10: Skype dial to mobile and regular phones.

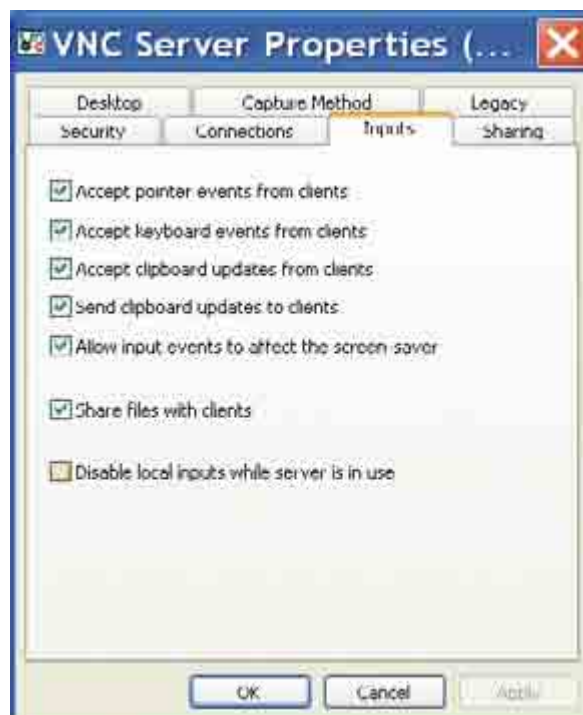


Plate 11: RealVNC server properties.

Table 3: Recommended CAD software.

Category	Examples of Software
2D and 3D architectural modelling software	3D Home Architect, *AutoCAD, Autodesk Architectural Desktop, Autodesk Revit Building, *ArchiCAD, Form-Z, TurboCAD.
Rendering software	3D Studio Viz, *AutoDesk 3D Studio Max, Accurender, AutoDesk Architectural Desktop, ArchiCAD, AutoCAD, Form-Z, TurboCAD.
Animation software	Amorphium , *AutoDesk 3D Studio Max, Autodesk Architectural Desktop, Blender, Bryce, Corel Photo Paint, Flash, Poser, Ray Dream Studio, SoftImage XS1, True Space. Most animation software can model and render.

Source: Field studies. The \* represents most popular software.

Table 4: Recommended graphics software, drivers and tools

Category	Examples of Software
Bitmap (photo) editing software	Adobe PhotoShop, Microsoft Paint, Corel Photo Paint, MicroGrafX Picture Publisher.
Vector graphics software	Corel Draw!, MicrografX Designer.
Presentation software	Microsoft Power Point, Harvard Graphics.
Desktop publishing software	Adobe PageMaker, Microsoft Publisher.
Device drivers	HP PhotoReal, Adobe Postscript, Scanner drivers, Digital camera drivers.
Software tools	Acrobat distiller, Acrobat Reader, Imaging for Windows.

Source: Field studies.

Viewer (Table 2). Both *Adobe Reader* and *Adobe Acrobat* can be used to view documents created in the *Adobe Portable Document Format* (PDF). However *Adobe Acrobat* in addition allows you to create PDF documents and add bookmarks and comments. *Adobe Reader* is very popular and can search documents and read contents out loud. *Zinio Reader* is very powerful software that can display digital magazines with a display quality rivaling the printed version. It can also search publications for phrases.

### 5.7 Media Players and DVD Software

Media players are required to view certain media such as films. Popular media players include *QuickTime* and *Windows Media Player*. DVD decoding software often requires that the right Codec be installed. Short for compressor / decompressor (coder / decoder), a codec is any technology for compressing and decompressing data. Codecs can be implemented in software, hardware, or a combination of both. Some popular codecs for computer video include MPEG, Indeo and Cinepak (dspvillage.ti.com, 2006). To create DVDs, DVD mastering software such as *Nero Premium* is required.



Plate 12: RealVNC viewer.



Plate 13: Zinio Reader splash screen.

## 6. CAD and Graphics Software

There is need to install powerful and current software for Computer Aided Design (CAD) and graphics (Ogunsote, 1989a; Ogunsote, 2001b; Ogunsote and Prucnal-Ogunsote, 2005). There is also need to install device drivers and software tools. This software is required to open and review downloaded documents and drawings and for preparing documents for transfer (Tables 3 and 4).

### 6.1 Software for Environmental Technology and Analysis

There is need to install software for acoustics, lighting and thermal

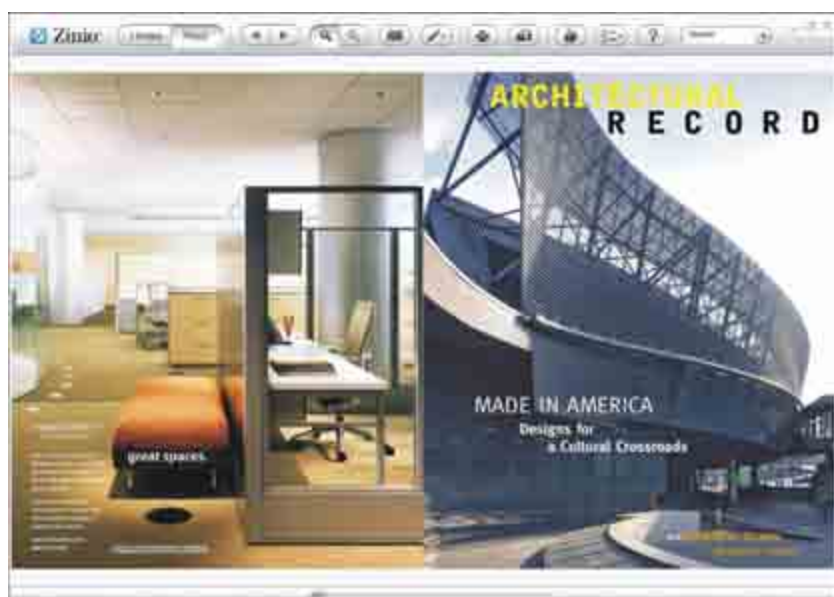


Plate 14: October 2006 issue of Architectural Record viewed in Zinio Reader.

analyses as well as structural design and planning (Ogunsote, 1989b; Ogunsote, 1991; Ogunsote and Prucnal-Ogunsote, 1987)

## **6.2 Open Source Software**

The current trend and technological direction in ICT today is the *Open Source* solution approach. *Open Source* means that the software codes of the application is freely available to use, modify, and make available to others under the Open Source Licenses Agreements. A simple, cost-effective but very reliable approach is the installation of the *Linux* operating system. There are various distributions and almost all are freely available. *Ubuntu Linux* is interestingly easier to learn and use. *Fedora Linux* has a lot of online forums whereby new users can be of help with the train-yourself approach. *Red Hat Linux* (enterprise edition is not free) has robust documentation and support from *Red Hat*. Quite a number of open source applications including office packages and graphics software are bundled with most of the *Linux* distributions. *Linux* also provides a starting point for students and teachers to begin developing their own open source solutions by learning from others.

## **7. Libraries and Databases**

The library contains a database of models, drawings, photographs as well as e-books and e-magazines.

### **7.1 Models, Drawings and Photographs**

The model database contains thousands of 3D models in 3DS, DWG and MAX format including maps, materials and luminaires. The 2D DWG drawings include thousands of blocks that can be inserted into 2D drawings. The photographs show modern Nigerian architecture in addition to contemporary trends in modern architecture.

### **7.2 E-books**

There are hundreds of electronic architecture books available for purchase on ebooks.com and ebooksmall.com. Free e-books are available from many web sites including library.com.edu. There are several sources of digital books on the web. Archnet.org is an online community for architects, planners, urban designers, interior designers, landscape architects, and scholars, with a special focus on the Islamic world. It has a digital library with publications, images and a gallery. Publications can be downloaded from the site. You can search for publications by author, title, building type, country, language and specific keywords.

The Online Books Page (onlinebooks.library.upenn.edu) lists more than 20,000 online books in English. All the books are free for personal and non-commercial use. You can search by author and title, and browse by subject. The site also lists freely accessible archives of magazines, journals, newspapers and other periodicals.

### **7.3 E-magazines**

The library contains e-magazines including *Architectural Record*. Digital versions of many architecture and planning magazines are now available through subscription. A single subscription is usually sufficient to allow all users to access a particular e-magazine. There are several architecture magazines that are available online. The University of Berkeley digital library (www.lib.berkeley.edu /ENVI), for example, has an environmental design library with a collection of electronic journals. While many of the journals are restricted to registered faculty members, most are free. The specific articles can be downloaded as PDF files. Many public libraries also offer digital collections and e-books, though registration is often required. See Tables 5, 6 and 7.

## **8. Alternate Virtual Personalities**

The exigencies of managing communication between hundreds of people have necessitated the creation of alternate virtual personalities for both resource persons and students. It is often required that a user must have a valid email address and profile when entering a security zone on the Internet. Internet software often disallows multiple logins using the same email address, for

Table 5: Selected Public and Federal Libraries.

Library	Web address
Chicago Public Library	<a href="http://www.chipublib.org">www.chipublib.org</a>
Library of Congress	<a href="http://www.locweb.loc.gov">www.locweb.loc.gov</a>
New York Public Library	<a href="http://www.nypl.org">www.nypl.org</a>
Philadelphia Free Library	<a href="http://www.library.phila.gov">www.library.phila.gov</a>
Queens Borough Public Library	<a href="http://www.queens.lib.ny.us">www.queens.lib.ny.us</a>

Source: Internet search.

Table 6: Selected University Libraries

Library	Web address
Columbia University Library	<a href="http://www.columbia.edu/cu/lweb">www.columbia.edu/cu/lweb</a>
Cornell University Library	www.campusgw.library.cornell.edu
Harvard University Library	www-hcl.harvard.edu
The University of the Witwatersrand Library	<a href="http://www.wits.ac.za/library">www.wits.ac.za/library</a>
MIT Library	www.libraries.mit.edu
Princeton University Library	www.infoshare1.princeton.edu:2003
University of California Library	www.sunsite.berkeley.edu
University of Chicago Library	<a href="http://www.lib.uchicago.edu">www.lib.uchicago.edu</a>
Yale University Library	<a href="http://www.library.yale.edu">www.library.yale.edu</a>

Source: Internet search.

example *Yahoo! Messenger*. It is also often necessary to set up contacts and settings for such software as *Skype*, *Windows Live Messenger* and *Outlook*. It is recommended that alternate virtual personalities be used for communication between staff and students of the Department. These personalities are assigned to groups and managed to simplify communication. There are separate alternate virtual personalities for resource persons and for students, distinctly separate from the user profiles of individuals. Another advantage of using these alternate personalities is that mail messages can be sent to a whole class without knowing the email addresses of the individual class members.

## 9. Special Data Formats for Remote Access to Graphic and Audio-Visual Data

One of the greatest challenges to e-learning and instant audio-visual communication on the Internet is the large volume of data involved in transfers. While a broadband connection and specialized hardware can help increase data transfer speed, the use of data compression at source and decompression at destination has been found to be very effective. The use of special data formats such as the DWF, JPEG, PDF, MPEG, RAR and ZIP formats for speedy access to remote data can reduce file size and download time by up to 10 times.

**DWF** The Design Web Format (DWF) is an open, secure file format developed by Autodesk for the efficient distribution and communication of rich design data to anyone who needs to view, review, or print it. Because DWF files are highly compressed, they are smaller and faster to transmit than design files, without the overhead associated with typical CAD drawings (www.autodesk.co.uk, 2006)

Table 7: Selected electronic journals.

Periodical	Web address	Comment
Architect Designed Houses	<a href="http://www.archmedia.com">www.archmedia.com</a>	Architect Designed Houses showcases domestic architecture by selected Australian architects. Architect Designed Houses features houses and renovations to suit a variety of styles and budgets.
Architecture Australia	<a href="http://www.archmedia.com.au">www.archmedia.com.au</a>	The official national magazine of the Royal Australian Institute of Architects. Published bi-monthly, it reviews the latest in Australian architecture and covers important issues relating to the profession.
Architecture SOUTH	<a href="http://www.specsite.com/w_grfx/007_a.html">www.specsite.com/w_grfx/007_a.html</a>	Journal of South-eastern United States architecture.
Design Intelligence	<a href="http://www.di.net">www.di.net</a>	Design Intelligence is a newsletter dealing with business and strategic issues for design professionals.
Architecture Resources	<a href="http://www.lib.berkeley.edu/ENVI/Architecture.html">www.lib.berkeley.edu/ENVI/Architecture.html</a>	The environmental design library of the University of Berkeley.
Architecture Electronic Journals	<a href="http://www.ejw.i8.com/archie-j.html">www.ejw.i8.com/archie-j.html</a>	A listing of many free electronic journals.
African Studies Ejournal	<a href="http://www.columbia.edu/cu/lweb/indiv/africa/ejournals.html">www.columbia.edu/cu/lweb/indiv/africa/ejournals.html</a>	Electronic journals and newspapers on Africa.
Architecture ejournal	<a href="http://www.lib.strath.ac.uk/engweb/archej.htm">www.lib.strath.ac.uk/engweb/archej.htm</a>	A University of Strathclyde list of electronic journals of relevance to Architecture available via the Library catalogue.
Electronic Journals and magazines	<a href="http://www.usg.edu/galileo/internet/electronic/elecjour.html">www.usg.edu/galileo/internet/electronic/elecjour.html</a>	An index of electronic journals and texts, including architecture journals.
Architecture Journals	<a href="http://www.architectstore.com/magazine.html">www.architectstore.com/magazine.html</a>	A web site with links to over 100 architecture magazines.

Source: Internet search.

Table 8: Alternate Virtual Personalities for Resource Persons and Students

Virtual Personality	Group Members
profogunsote@yahoo.com	Prof. Ogunsote Office Staff
futyarc100l@yahoo.com	FUTY Architecture 100 Level students
futyarc200l@yahoo.com	FUTY Architecture 200 Level students
futyarc300l@yahoo.com	FUTY Architecture 300 Level students
futyarc400l@yahoo.com	FUTY Architecture 400 Level students
futyarc500l@yahoo.com	FUTY Architecture 500 Level students
futyarcstaff@yahoo.com	FUTY Architecture Staff

**JPEG** The Joint Photographic Experts Group (JPEG) format is a standard colour picture compression mechanism. This "lossy" compression scheme sacrifices some image quality in exchange for a reduction in the file's size (www.mindwrap.com, 2006).

**PDF** The Portable Document Format (PDF) is a postscript file format used by the Adobe Acrobat software to capture all the elements of a printed document as an electronic image that you can view, navigate, print, or forward to someone else. PDF is the de facto

standard for the secure and reliable distribution and exchange of electronic documents and forms around the world. PDF is a universal file format that preserves the fonts, images, graphics, and layout of any source document, regardless of the application and platform used to create it. Adobe PDF files are compact and complete, and can be shared, viewed, and printed by anyone with the free Adobe Reader software ([www.data-core.com](http://www.data-core.com), 2006).

**MPEG** The Moving Picture Experts Group (MPEG) format is the standard for compression and storage of data, audio and motion video, for example, videos available through the World Wide Web ([www.bmrc.berkeley.edu](http://www.bmrc.berkeley.edu), 2005).

**ZIP** A file in the ZIP format is a file that has been compressed into an archive so that it occupies less disk space. There are several free compression utilities for zipping and unzipping files with *WinZIP* being one of the most popular.

**RAR** This is a very efficient method for compressing files. RAR works like ZIP files do on Windows. RAR files are 'archives' which can contain one or more compressed files. RAR files can also be segmented into smaller chunks ([www.techsono.com](http://www.techsono.com)). A popular utility for creating and decompressing RAR files is the *WinRAR* utility.

## **10. Implementations of E-learning systems**

There are several implementations of e-learning systems including The Massachusetts Institute of Technology (MIT) OpenCourseware (OCW), The African Virtual Open Initiatives and Resources (AVOIR) project and the National Universities Commission (NUC) e-Learning Project and the African Virtual University.

### **10.1 OpenCourseWare**

OpenCourseWare (OCW) is a new learning dimension pioneered by the Massachusetts Institute of Technology (MIT) which allows people all over the world to tap into the reserves of knowledge from major institutions around the globe (Festa, 2003). OpenCourseWare is based on the free-for-all philosophy that will hopefully control future access to learning and teaching materials especially in digital formats.

The MIT OCW is a free and open educational resource (OER) for educators, students, and self-learners around the world. It is a publication of MIT course materials and does not require any registration. It covers more than 1400 courses, almost a hundred of which are in architecture. Although it is not degree awarding and does not provide access to MIT faculty, educators and students everywhere can benefit from the academic activities of the faculty and join a global learning community in which knowledge and ideas are shared openly and freely for the benefit of all ([www.ocw.mit.edu](http://www.ocw.mit.edu), 2006). Almost a hundred universities in China, France, Japan, the United States and Vietnam have committed to the open publication of their materials in OCW initiatives. The MIT OCW is currently being translated into Spanish, Portuguese and Chinese.

The recent workshop by the National Universities Commission (NUC) on Webometric Ranking of Universities (Omofaye, 2006b) encouraged publishing of scholarly materials on university websites with a view to showcasing the results of academic and research activities in our universities. The workshop aimed at helping each university establish a web presence that is rich in scholarly materials that can impact positively on studies.

### **10.2 The African Virtual Open Initiatives and Resources (AVOIR) project**

This project, in collaboration with the University of Jos is still in its infancy. The objective of the project is to use the *Next Generation* software for e-learning (Okewu, 2006).

### **10.3 National Universities Commission (NUC) e-Learning Project**

E-learning is one of the four components of the NUC's Quadrangle Concept. Others are the National Virtual Library Project, the Nigerian Universities Management Information System (NUMIS) and the Nigerian Universities Network (NUNet). The e-learning project is still very much in its infancy, though a few tutorials on computer appreciation and networking are available for download.

#### **10.4 E-Learning-Africa**

This is an annual conference for building e-learning capacity in Africa and a forum for all stakeholders engaged in the planning and implementation of technology-supported learning and training on the African continent. The 1st e-learning Africa International Conference on ICT for Development, Education and Training took place at the United Nations Conference Centre, Addis Ababa, Ethiopia in May, 2006. The post-conference report is a progress report on e-learning in Africa (eLearning Africa, 2006; Omofaye, 2006a).

#### **10.5 African Virtual University**

The African Virtual University (AVU) is an innovative educational organization established to serve the countries of Africa. The objective of the AVU is to build capacity and support economic development by leveraging the power of modern telecommunications technology to provide world-class quality education and training programs to students and professionals in Africa. After a successful pilot phase, AVU has been transformed from being a project of the World Bank to an independent inter-governmental organization based in Nairobi, Kenya with over 57 Learning Centres in 27 African countries ([www.avu.org](http://www.avu.org), 2006). The teaching methods include a blend of online and in-class learning and flexible delivery systems, combining e-learning, discussions with onsite facilitators, web-seminars and video broadcast. While most of the courses offered are in Computer Science, Engineering and Business Administration, the digital library is very useful. Nigeria is an associate member of the AVU with a learning centre at the Obafemi Awolowo University, Ile-Ife ([lkehinde@oauife.edu.ng](mailto:lkehinde@oauife.edu.ng)).

### **11. Training and Maintenance**

#### **11.1 Training**

There is need to conduct special training for both staff and students on the use of computer communication and e-learning software. Special seminars and workshops should be organised, probably on a University wide basis to familiarize participants with the latest technology used for e-learning.

#### **11.2 Maintenance, Spare parts and Equipment**

The equipment is likely to be heavily used and some accessories may require regular replacement. A keyboard or a mouse may need a replacement at an average of about 6 months. The stabilizer should be adequate to withstand power fluctuations. The depreciation of the equipment should be kept in view by means of adequate future budgets. Spares kept in stock should include keyboard, mouse, switch, and spare fuses. The wiring of the building should ensure proper earthing while the VSAT may need lightning protection.

#### **11.3 Data Backup**

A good backup system should be developed for departmental and students data. Maintaining a library of downloaded documents will economize the usage of equipment by reducing the need to download the same document repeatedly. Configuration of a software web proxy will also speed web page download time.

### **12. Phasing and Implementation**

#### **12.1 Phasing**

The establishment of a direct communication link with the Department for e-learning and communication is an experimental project. The rapid advances in computer technology can easily render relatively new concepts and configurations obsolete. There is therefore need to implement the project in phases and make necessary adjustments based on experience gained and local conditions. The implementation of the project will be in 3 phases (Table 9).

Table 9: Implementation Phases

Phase	Description
Initial Setup	Installation of VSAT, power infrastructure, trunking and cabling, hardware and software. Test running and training.
Campus-wide coverage	Outstanding power infrastructure, trunking and cabling, hardware and software. Procurement of multimedia equipment, campus-wide coverage, database consolidation. Seminars and workshops.
National coverage	Integration into nation-wide e-learning and communication systems. Conferences.

## 12.2 Costing and Funding

A possible scenario for funding the e-learning project is presented in Table 10.

Table 10: A possible scenario for funding e-learning

Cost Centre	Funding
Procurement and installation of VSAT, reliable power infrastructure, computer hardware, computer software and subscriptions to architecture magazines and journals.	The University with support from private individuals, national and international organizations.
Training, seminars, workshops and conferences.	Registration fees with support from private companies, national and international organizations.
Maintenance, upgrading and refurbishment.	Students through laboratory fees.
Consumables such as paper and cartridges.	Students through laboratory fees.

## 13. Conclusion

The successful implementation of the first phase of the project in FUTY is a clear indication that e-learning in architectural education is feasible within the current infrastructural and technological constraints.

## 14. Recommendations

It is recommended that Schools of Architecture should encourage e-learning by acquiring electronic books and subscribing to electronic journals. The creation and management of databases for models, drawings and photographs in addition to documents should be initiated. Schools of Architecture should acquire fast internet connectivity for easy integration into the planned national network of architecture schools. It is imperative that online forums and blogs be set up specifically for architectural students and educators to enable information sharing.

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