OPEN EDUCATIONAL RESOURCES WITH SPECIAL REFERENCE TO BIOLOGY TEACHING AND RESEARCH AID IN ETHIOPIA

Sanjoy Kumar Pal
School of Animal & Range Sciences
Haramaya University, Dire Dawa, ETHIOPIA
sanjoypal@yahoo.com

Dr. Manas Ranjan Panigrahi
Department of Educational Planning and Management
College of Education and Behavioural Sciences
Haramaya University, Dire Dawa, ETHIOPIA
manasedn@yahoo.com

Abstract

Information and Communication Technology (ICT) is now playing an important role to support teaching and dissemination of knowledge. ICT has virtually revolutionized the teaching and learning process globally. Ethiopia has witnessed the development of ICTs in various sectors over the last decade including education. With the spread of Internet it is now possible to assess all kinds of teaching and research information of unbelievable proportions. Internet now provides a variety of resources for all users. Although the classroom lectures continue to be used as the primary method of teaching biology. The lectures that used to be primarily chalk and blackboard have now started incorporating multimedia resources to enhance teaching and complement demonstration. Video presentation makes it easier to explain complicated topics in biology. It is now possible to show many real time action & reactions and three-dimensional models of atoms and molecules moving freely in space. Though Internet offers rich sources of potential teaching aid that can be used to enhance the classroom teaching, it is often too challenging for anyone to filter out the high quality useful information from the Internet. Special skills are required to fish out required information from the Internet. In this article some useful websites that provide quality information on biology and which may aid in the e-learning process are discussed. In the coming year's ICT is going to play a key role in enhancing and providing sustainable quality education in schools and colleges in Ethiopia. Hence, urgent attention should be given to strengthen the infrastructure facilities, training of teachers and implementation of ICT-related teaching models that encourage learning processes by use of ICT. Emphasis must also be placed on the pedagogy beside the use of ICT.

Key Words: Biology Teaching Resources, e-learning, Ethiopia, ICT, OER.

INTRODUCTION

Science educators and school science teachers have been continuously looking for ways to create environment for active learning – in which, students' attention is captured and their minds are engaged (Lin et al., 2002). After the advent of Information and Communication Technology (ICT) the teaching and learning process has virtually got revolutionized globally. ICT is now playing an important role for the dissemination of sustainable quality education worldwide. Information ICT is defined as a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information. These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephone (Blurton, 2002).

With the wide spread use of ICT, the most beneficent end-users are mainly the students and teachers. Variety of information on any subject is now freely available on the Internet. With some basic knowledge of how to navigate the Internet one can have access to any kind of information. Gathering of new information that would

have taken days of library search earlier can now be done in matter of minutes using the Internet (Pal et al., 2001). Nobody can deny that the deployment of information technology has profoundly altered not only the way we live and work today but also our reading and learning experience (Panigrahi, 2011). A new way of learning experience that has emerged with Internet is the Virtual Learning Environment (VLEs). The VLEs today include a plethora of alternative teaching spaces including, Internet based courses (Ferguson and Wijekumar, 2000), tele-conferencing courses and virtual reality courses. The common link for all environments is that students come to a 'place', or use a technology to link them to a place to acquire new knowledge (Peat, 2000).

The potential of ICT in secondary biology teaching is enormous, although it is a huge undertaking and fairly daunting to newcomers (Peat and Fernandez, 2000). Computer learning packages and the web can offer a variety of opportunities for learning, ranging from non-interactive content to highly interactive student-centred learning experience. Biology teaching has been deeply changing with ICT (Lombard, 2008). There is a plethora of media and multimedia resources available that can be used in the lecture classroom to enhance teaching and complement demonstrations and other teaching aid (Francis, 2000). However, the field of information technology is so new and changing so speedily that one has to update himself/herself regularly to keep pace with this fast changing world. Moreover, the Internet is like an ocean and without proper navigational skills one is likely to get lost.

The use of ICT in African countries is increasing and dramatically growing (Adeyinka et al., 2007). Ethiopia has witnessed the development of ICTs in various sectors over the last decade including education. Overcoming all constraints ICT is likely to penetrate all schools and colleges of the country. Hence, urgent attention should be given to train teachers and professionals to support ICT-related teaching models. In this article information is provided on some basic Internet navigation tools, useful teaching resources, and some miscellaneous information that can help teachers, researcher and students of biology.

METHOD

The information was collected by using the internet service provided by Haramaya University.

Navigating The Internet
The Internet is a large, worldwide network of interconnected computers. It consists of several communication media, the best known of which is the World Wide Web. The principal communication protocol of the Internet is TCP/IP (Transmission control protocol/internet protocol), developed in the 1970s by the US Department of Defence. It was designed to connect networks of different vendors into a "network of networks" [The Internet] (Pal et al., 2001). The World Wide Web referred to as www is one interesting and popular development. It offers user-friendly access to million of pages of information on computer all over the world. It is now possible to link our computer to computer/s all around the world through Internet. Sitting at a computer terminal in a remote part of the world, one can search for virtually any information of interest from all over the world. However, because of the enormous content of the World Wide Web, it is important to know how to search the web effectively to avoid wasting of time. Three things are important to perform a successful search: i.) Web browser, ii.) Search engine, iii.) Download managers.

i) **Web browser:** Commonly referred to as a browser is a software application for retrieving, presenting and traversing information resources on the World Wide Web. An information resource is identified by a Uniform Resource Identifier (URI) and may be a web page, image, video or other piece of content. Hyperlinks present in resources enable users easily to navigate their browsers to related resources. A web browser can also be defined as an application software or program designed to enable users to access, retrieve and view documents and other resources on the Internet. The major web browsers are Chrome, Firefox, Internet Explorer, Opera, and Safari.

ii) **Search Engine:** A search engine is an information retrieval system designed to help find information stored on a computer system. The information may be a specialist in web pages, images, information and other types of files. The search results are usually presented in a list and are commonly called hits. Search engines help to minimize the time required to find information and the amount of information which must

be consulted. Some search engines also mine data available in databases or open directories. The most popular search engines are Google, Yahoo, Baidu, Bing, Rediff etc.

iii)   **Download Managers**: A download manager is a computer program dedicated to the task of downloading (and sometimes uploading) possibly unrelated stand-alone files from (and sometimes to) the Internet for storage. Some download managers can also be used to accelerate download speeds by downloading from multiple sources at once. Although web browsers may have download managers incorporated as a feature, they are differentiated by the fact that they do not prioritize accurate, complete and unbroken downloads of information. There comes a time when you are downloading a large file and the download stops part of the way through. If you are using the Windows download applet there is nothing you can do about it; you will just have to start again. A good download manager will allow you to resume the download, picking up where it left off. Good download managers also allow you to start several concurrent download sessions from available resources for the one file. This works by splitting the file into parts with each part downloaded at the same time from multiple or mirrored resources. At the end the file is re-assembled, by joining all the pieces by the download managers. Some popular download managers are Internet Download Manager (IDM), Download Accelerator Plus, Download Express, FlashGet, GetGo, Orbit Downloader. Information of freely available download managers can be obtained from: [http://www.techsupportalert.com/best-free-download-manager.htm].

The easiest way to fish out the desired information from the internet is to obtain the exact Uniform Resource Locator (URL). If one knows the address for a particular website, the same can be typed into the location box of the browser and the user will automatically be connected to the correct site. Most of the time, however, the exact address will be unknown. In this case, a search engine can be used. We have searched the internet and found many interesting websites that may be useful for biology teachers and students; a list is given in table.

Table 1: Web addresses of interesting sites

Biology	http://biology.slss.ie/
Biology Online	http://www.biology-online.org/
Biology Corner	http://www.biologycorner.com/
The Biology Project	http://www.biology.arizona.edu/
Principles of Molecular Biology	http://bbruner.org/107main.htm
Human Biology	http://www.teachingideas.co.uk/science/contents_humans.htm
Biology Junction	http://www.biologyjunction.com/
Biology Education Online:	http://www.accessexcellence.org/LC/BEOn/aboutbeon.php
Biology Animation Library	http://www.dnalc.org/resources/animations/
DNA Today	http://www.dnalc.org/resources/dnatoday/index.html
DNA Learning Centre	http://www.dnalc.org/resources/
Biology Spark Notes	http://www.sparknotes.com/biology/
Biology Cliff Notes	http://www.cliffsnotes.com/study_guide/Biology.topicArticleId-8741.html
IB Biology Notes	http://www.ibguides.com/biology/home
Free Biology Video	http://www.learnerstv.com/Free-Biology-video-lecture-courses.htm
Biology Video Clips	http://www.goldiesroom.org/video_archive.htm
Online Biology Video Lessons	http://www.brightstorm.com/science/biology/
ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/video-lectures/	
//www.youtube.com/playlist?list=PL7A750281106CD067	
Biology Video Lecture	http://freevideolectures.com/Course/2548/Biology
Biology Resource Page	http://www.learnerstv.com/biology.php
Biology Lecture [PPt]	http://www.curriki.org/
Teachers Network	http://teachersnetwork.org/?gclid=CPP27PXahbYCFa9aMgodQxQAwA
Biology Learning Guide	http://www.shmoop.com/biology/
Biology Teaching & Learning	http://www.biology-resources.com/
Association for Biology Teacher	http://www.nabt.org/websites/institution/index.php?p=38
Resource for teaching Biology	http://www.csun.edu/science/biology/index.html

Practical Biology	http://www.nuffieldfoundation.org/practical-biology
Biology Teacher Resource Bank	http://store.aqa.org.uk/qual/gce/pdf/AQA-2410-W-TRB-RL.PDF
Human Biology Resources	http://store.aqa.org.uk/qual/gce/pdf/AQA-2405-W-TRB-RL.PDF
BioDIDAC Digital Resources	http://biodidac.bio.uottawa.ca/

Wikipedia: http://www.wikipedia.org

Wikipedia is a multilingual, web-based, free-content encyclopaedia project operated by the Wikimedia Foundation and based on an openly editable model. The name "Wikipedia" is a portmanteau of the words wiki (a technology for creating collaborative websites, from the Hawaiian word wiki, meaning "quick") and encyclopaedia. Wikipedia's articles provide links to guide the user to related pages with additional information. Wikipedia is written collaboratively by largely anonymous Internet volunteers who write without pay. Anyone with Internet access can write and make changes to Wikipedia articles, except in limited cases where editing is restricted to prevent disruption or vandalism. Users can contribute anonymously, or with their real identity. Since its creation in 2001, Wikipedia has grown rapidly into one of the largest reference websites, attracting 470 million unique visitors monthly as of February 2012. There are more than 77,000 active contributors working on over 22,000,000 articles in 285 languages. As of today, there are 4,186,541 articles in English. Every day, hundreds of thousands of visitors from around the world collectively make tens of thousands of edits and create thousands of new articles to augment the knowledge held by the Wikipedia encyclopaedia.

YouTube: http://www.youtube.com

YouTube is a video-sharing website, created by three former PayPal employees in February 2005, on which users can upload, view and share videos. The company is based in San Bruno, California, and uses Adobe Flash Video and HTML5 technology to display a wide variety of user-generated video content, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging, short original videos, and most importantly educational videos. Most of the content on YouTube has been uploaded by individuals, although media corporations including CBS, BBC, National Geography, History Channel, VEVO, Hulu, and other organizations offer some of their material via the site, as part of the YouTube partnership program. In November 2006, YouTube, LLC was bought by Google, and now operates as a subsidiary of Google.

Digital Video Resources

A variety of different video-based technologies are available over the internet. Most of them offer the ability to view short compressed film sequences as well as computer-based animation (Francis, 2000). Most of the video players are user-friendly and offer several different display options. Popular formats include: Moving Picture Expert Group (MPEG), QUICKTIME[TM] (Apple's video player; it has a Windows[®] version), Video for Window[®] format (AVI); K-Multimedia Player (KMP), a Korean media player software that runs on Microsoft Windows. Each video player play files in its own format.

DATABASES

Databases may contain bibliographic, factual/statistical information or images. Data is usually accessed by searching for a specific term or selecting from a browseable menu. Many bibliographic databases require a subscription, but there are some free ones. Here are some site addresses of Bibliographic Databases:

Biology Digest: http://www.csa.com/factsheets/biodig-set-c.php

Biology Digest is a compilation of abstracts and indexes of domestic and international literature in the area of life sciences. Made available by ProQuest-CSA, this database aims to keep students, academics, and researchers aware of the latest developments in biological research. Subscription required.

Zoological Record: http://scientific.thomson.com/products/zr/

Zoological Record is a database of animal biology with coverage that extends back to 1864. Its scope of coverage represents every area of animal biology from biodiversity and the environment, to taxonomy and veterinary sciences. Zoological Record covers 5,000 serials and other sources of information including books, reports, and meetings. Subscription required.

UK PubMed Central: http://ukpmc.ac.uk/

UKPMC is a free-to-access online digital archive of full-text, peer-reviewed research publications in the biomedical and life sciences journal literature. Fully searchable and provides context-sensitive links to other online resources, such as gene and chemical compound databases.

American Society for Cell Biology: Image & Video Library: http://cellimages.ascb.org/

The Image & Video Library (IVL) is an extensive collection of peer-reviewed cell images, videos, and digitised texts. This free educational resource is published by the American Society for Cell Biology.

Biology Animation Library: http://www.dnalc.org/ddnalc/resources/animations.html

Made available by the Dolan DNA Learning Center, this collection of animations features some of the most common molecular processes such as PCR, sequencing, and DNA restriction. Available for viewing online or download to your computer.

Professional Associations and Societies:

Many key national and international organisations, learned societies, and research bodies have websites, which contain useful information, guidance, reports, and other key materials. Here are some site addresses of Professional Associations and Societies:

Tropical Biology Association: http://tropical-biology.org/

The TBA is a non-governmental, non-profit organisation working in partnership with environmental institutions throughout the Africa region.

British Society for Cell Biology: http://www.bscb.org/

The BSCB aims to promote and advance research in all branches of cell biology and encourages the interchange of information.

European Molecular Biology Organization (EMBO): http://www.embo.org/about_embo/

A membership organisation of leading researchers in Europe representing a cross-section of the life sciences community.

American Society for Microbiology: http://www.asm.org/

The ASM is the world's largest scientific society of individuals interested in the microbiological sciences.

Institute of Biology: http://www.iob.org/

The Institute of Biology (IOB) is the professional body representing UK biologists with a membership of more than 14,000.

The Genetics Society: http://www.genetics.org.uk/

The Genetics Society has more than 2,000 members, consisting of most of the UK's active professional geneticists, including teachers, researchers, and students. Industry and publishing are also well represented in their membership.

British Society for Immunology: http://www.immunology.org/

The British Society for Immunology (BSI) website provides resources for both practitioners of immunology and the wider public.

INFORMATION & COMMUNICATION TECHNOLOGY AND SCIENCE EDUCATION

The challenge for science teacher educators is to develop pedagogies and employ technologies which embraces 'communities of practice' as core to both science practice and teacher learning (Duncan and Chandler, 2011). The global change in science curriculum arising from knowledge explosion and new wave in science and technology development demands for qualitative science teaching (Joseph and Joy, 2011). The change calls for the provision and utilization of resources which tend to enhance the effective teaching and learning of science.

The classroom lectures continues to be used as the primary method of teaching biology (Francis, 2000). Lecture styles that incorporate a variety of innovative teaching methods are essential if one is going to gain the attention of students raised in our media-saturated culture. There is a plethora of media and multimedia resources available that can be used in the lecture classroom to enhance teaching and complement demonstrations and other teaching aids. Most of the material can be accessed free of charge or for a small registration fee.

Introductory biology instruction often involves some reference to the atomic-molecular level of life. Many students in introductory courses have difficulty visualizing the three-dimensional shape of atoms and molecules, especially if the students' exposure is limited to two-dimensional stick drawings and figures. When students can visualize three-dimensional models of atoms and molecules moving freely in space, they gain a greater appreciation for how they make up biological structures. Obviously, hands-on models work well, but for the lecture classroom molecular viewers offer a great advantage over chalkboard drawings (Francis, 2000).

Internet now offers a unique opportunity for distance learning and professional development for teachers. It can also aid in online in-service education and training (INSET) activities. Study carried out in Turkey suggest that with online INSET activities, especially time and place dependency can be overcome, and accommodation and transportation issues can be resolved. Teachers feel that online INSET activities can promote effective use of resources (Kokoc et al., 2011). Moreover, it has been found that teleconferences can motivate teacher to develop teaching-learning materials (Panigrahi, 2012).

CHALLENGES OF ICT IMPLEMENTATION

In the 18th century we had the agrarian revolution; the industrial revolution followed in the 19th century, in the 20th century came the technology revolution, and now starting of this millennium we have the information revolution. In the past few years with the use of ICTs in education there has being a paradigm shift from the teacher-centred education system to learner centred education the world over (Baggotta et al., 1997). However, while there is a great deal of knowledge about how ICTs are being used in developed countries, there is limited information on how ICTs are being introduced into schools in developing countries (Adeyinka et al., 2007). Though there are many hurdles to overcome, ICT use in education is at a particularly dynamic stage in Africa; new developments and announcements are happening on a daily basis somewhere on the continent (Farrell and Isaacs, 2007).

Encountering different challenges Ethiopia has made the development of information and communications technology one of its strategic priorities. The ICT policy is a demonstration of its commitment to the development of ICT both as an industry and as an enabler of socio-economic transformation (FDRE, 2005). To counter the significant educational challenges from primary through tertiary level the government has undertaken different programs and strategies to bring educational reforms in the country (Wakgari et al., 2013). ICT is one such approach that may bring drastic change in the way which education is delivered. The effective integration of ICTs into the educational system is still a complex and multifaceted process. However, once the various challenges like infrastructure, curriculum and pedagogy, capacity-building, language and teacher competencies are overcome ICT will play a key role in enhancing and providing sustainable quality education in schools and colleges in Ethiopia.

CONCLUSION

ICT has radically changed the way the science (biology) is taught in the developed world. The Internet is providing tremendous resources for science educators, it is now possible to get software, multimedia technology, and establish communication links with libraries and teacher from all over the world. ICT could provide sustainable quality education in schools and colleges throughout Ethiopia. As ICT can help to make lecture more interesting, challenging and thought provoking, will thus promote positive student outcome. If the future generation of students receives high-quality knowledge in science can set the stage for rapid scientific development in the country. Hence, urgent attention should be given to support ICT-related teaching models that encourage both students and teachers to play an active role in teaching/learning activities.

PS: One note of caution is that internet addresses are subject to change. This is very frustrating. There are two things one can do if the internet address of a particular resource has changed. Try using the incorrect address anyway since it may lead to the correct address, or use a search engine to locate the new URL. It may be also possible that the server of the particular website can be temporarily down for maintenance.

REFERENCES

Baggotta, L.; Nicholb, J. and Ellisonc, P. (1997). Educational Informatics for the Biology Teacher. *J Biol Edu*, Vol. 31: 189-196.

Blurton, C. (2002). New Direction of ICT use in Education, Available online: http://www.unesco.org.

Duncan, J.C. and Chandler, P.D. (2011). A Community of Practice for Early Career Biology Teacher: Social Networking and Digital Technologies. Paper presented at the *Contemporary Approaches to Research in Mathematics, Science, Health and Environmental Education*, Deakin University, Burwood, Victoria. http://acu-au.academia.edu/PaulChandler/Digital-Pedagogy_(Retrieved on 14.03.2013).

Farrell, G and Isaacs S. Survey of ICT and Education in Africa: A Summary Report, Based on 53 Country Surveys. 2007.Washington, DC: infoDev / World Bank.
http://www.infodev.org/en/Publication.353.html (Retrieved on 20.03.2013).

FDRE (2005). Federal Democratic Republic of Ethiopia: ICT policy (draft), Addis Ababa.

Ferguson, L. and Wijekumar, K. (2000). Effective Design and Use of Web-based Distance Education Environments. *Professional Safety*, Vol. 45(12), 28-33.

Francis, J.W. (2000). Use of Internet Resources in the Biology Lecture Classroom. *The American Biology Teacher*, Vol. 62(2), 90–93.

Kokoc, M.; Ozlu, A.; Cimer, A. and Karal, H. (2011). Teachers' Views on the Potential Use of Online In-service Education and Training Activities. *Turkish Online Journal of Distance Education-TOJDE,* Vol. 12(4), 68–87.

Lin, C.; Cheng, Y.; Chang, Y. and Hu, R. (2002). The use of Internet-based Learning in Biology. *Innovations in Education and Teaching International (IETI),* Vol. 39, 237–242.

Lombard, F. (2008). Information Technology (IT) to Change Biology Teaching or Teaching IT-changed Biology.
http://tecfa.unige.ch/perso/lombardf/publications/bioed-dijon-08/lombard-dijon-08-texte.pdf (Retrieved on 14.03.2013).

Obomanu, B.J. and Akporehwe, J. (2011). Resources for Teaching Secondary School Biology in Bayelsa State of Nigeria. *Information and Knowledge Management,* Vol. 1, 28-35.

Pal, S.K.; Nazir, A.; Mukhopadhya, I.; Saxena, D.K. and Chowdhuri, D.K. (2001). Internet: A Major Resource for Toxicologist. *Indian Journal of Experimental Biology,* Vol. 39, 1207-1213.

Pal, S.K.; Singh, M.K.; Pandey, G.S. and Mittal, B. (2001). Internet Resources for Human Geneticist. *Indian Journal of Experimental Biology,* Vol. 39, 503–510.

Panigrahi, M.R. (2011). Perception of Teachers' Towards Extensive Utilization of Information and Communication Technology. *Turkish Online Journal of Distance Education-TOJDE*, Vol. 12(4), 45–57.

Panigrahi, M.R. (2012). Capacity Building of Teachers through Distance Mode Using Teleconferencing as an Innovative Tool. *Turkish Online Journal of Distance Education-TOJDE,* Vol. 13(2), 256–266.

Peat, M. and Fernandez, A. (2000). The Role of Information Technology in Biology Education: An Australian Perspective. *Journal of Biological Education*, Vol. 34(2), 69-73.

Peat, M. (2000). Towards First Year Biology Online: A Virtual Learning Environment. *Educational & Society*, Vol. 3(3). http://www.ifets.info/journals/3_3/b06.html (Retrieved on 14.03.2013).

Wakgari, T.; Sani, D. and Panigrahi, M.R. (2013). Information Communication Technology for Educational Quality: Challenges, Prospects in Ethiopian Context. *Turkish Online Journal of Distance Education-TOJDE*, Vol. 14 (Accepted for publication, April issue).