# Utilizing Virtual Learning and a Virtual GIS Computer Laboratory in Spatial Sciences Learning for the Expanded Open Distance Education at Mzuzu University

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# INTRODUCTION

- Mzuzu University was established by Act of Parliament of July 1997 as second national university

- Open Distance Learning (ODL) mode was adopted in July 2006 to address issue of limited access to tertiary education in Malawi

- Currently ODL centres are being constructed across the country so that instruction takes place right away in areas where students are.

- GIS, as an evolving technology, has been integrated in the mainstream undergraduate as well as graduate curricula of Mzuzu University.

- Being multidisciplinary and technologically enabled discipline, the relevance of spatial sciences and GIS sees no boundary (geography, geomatics, land management, forestry, agriculture, water management etc)

- GIS Curriculum therefore is suitable for the advancements of learning models adaptable to learners of different disciplinary backgrounds.

- Various multimedia and internet technologies have been adopted in the delivery of distance education programs and courses.

- Advancements in information technology have challenged instructors as to *what* to teach as well as *which* technology to use to teach.

- Web-based and interactive multimedia technologies have changed many on-campus courses into Web-facilitated, hybrid, and distance education courses.

- Hybrid courses use both traditional face-to-face teaching and a considerable portion of online delivery.

- A virtual learning environment comprise of tools designed to enhance students' learning experience by incorporating computers and the Internet in the learning process.

- It allows users to collaborate in a variety of multisensory interactions.

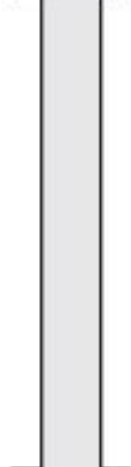# Distinguishable Elements of a Virtual Learning Environment

a) delivery type— audio, video-based systems

b) delivery media (e.g., books, journal articles, CD, DVD, Internet);

c) communication type (synchronous and asynchronous) and student involvement (active and passive);

d) degree of abstraction and content (e.g., text, maps, 3Dmodels, 4D simulations, interactive virtual models);

e) presence of instructor and accessibility of instructor by students;

f) degree of interactivity among students, instructor, and computerized entities, and

g) user access.

# Traditional Virtual GIS Learning Systems

1. Instructor-Student interaction/face-to-face interaction.

2. Student-centred and self-paced instruction.

3. Web GIS and virtual GIS tools, which are student-computer centered.

- These however are considered to be a preliminary to teaching GIS and spatial sciences.

- There is need for an innovative hybrid system

**Student involvement**

Passive

Active

Textbooks, journal articles

Power Point, maps

GIS demos (videoclips) on external media (CD,DVD) or streamed video

Digital lectures (video, audio)

Interactive webGIS; quizzes

Case studies incl. discussion; group projects

Hands-on assignments / student projects using GIS software
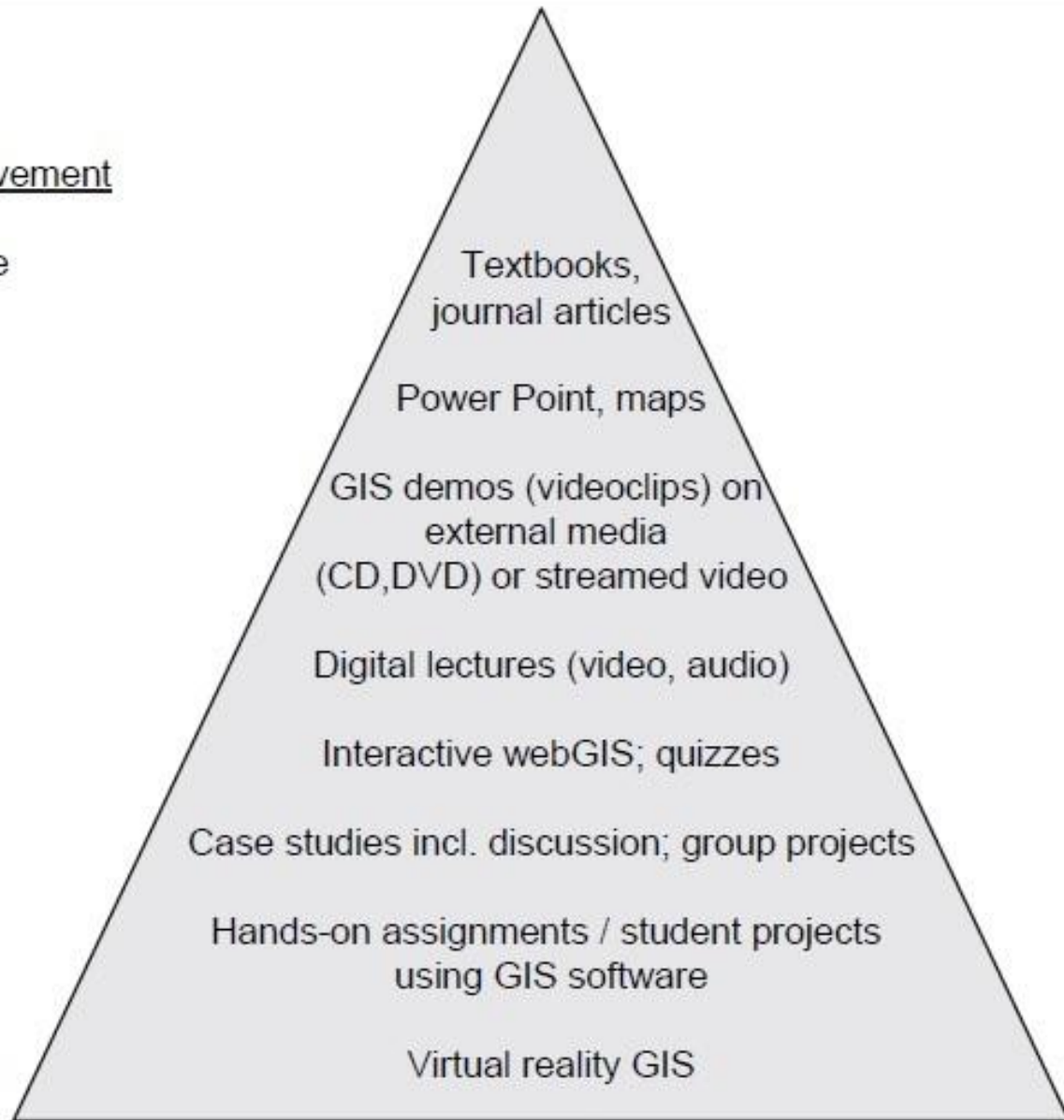
Virtual reality GIS

**Fig. 1. Delivery types of content to teach GIS and spatial sciences courses Adopted from: Grunwald et. al. (2007)**
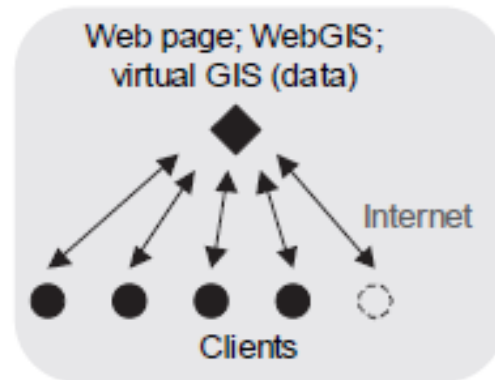
# Architectures of Virtual GIS Learning Environments

- These range from centralized, closed systems to complex, distributed open systems.

- Their difference is on the manner spatial datasets can be accessed.  E.g.

a)    Can be hosted on a desktop computer,

b)    Can be a computerized entity providing data and/or map services,

c)    Can be a server, or

d)    Can be nodes that are part of a distributed open system (Pseng & Tsou, 2003).

- Similarly, different architectures facilitate different access to GIS software. E.g. in a centralized, closed system the GIS software is installed on a desktop machine while client/server systems require that the GIS software is installed on all client machines.
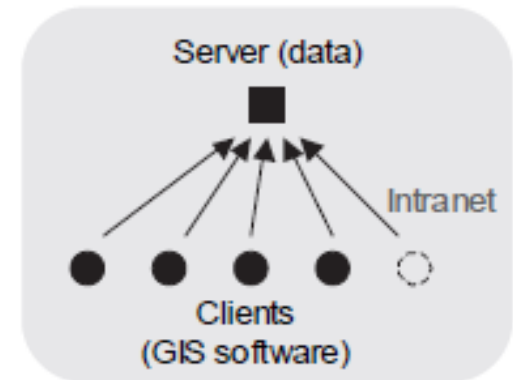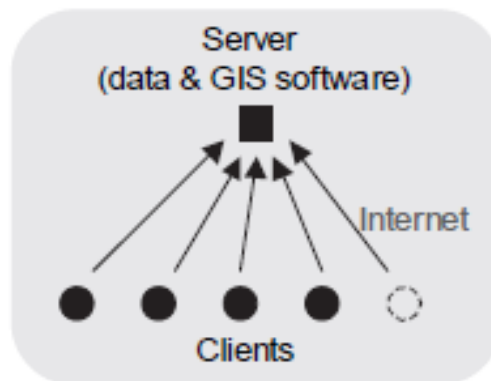
**(a) Centralized, closed system**

Desktop computer (data & GIS software)

**(b) Web-facilitated instruction**

Web page; WebGIS; virtual GIS (data)

Internet

Clients

**(c) Client / server system**

Server (data)

Intranet

Clients (GIS software)

**(d) Hybrid system**

Server (data & GIS software)

Internet

Clients

**(e) Distributed open system**

Node$_1$   Node$_3$   Node$_x$
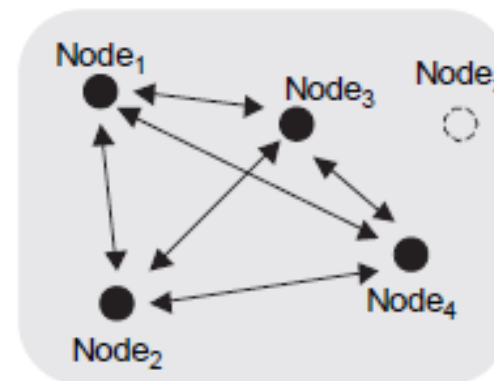
Node$_2$   Node$_4$

**Fig. 2. Architectures for teaching Spatial Sciences**
**Adopted from: Grunwald et. al. (2007)**

- Considering the various architectures, there is need for an all-inclusive architecture that uses an innovative hybrid setup, where GIS software is installed only on the server.

# WHY THIS INNOVATIVE HYBRID ARCHITECTURE?

- It eliminates the need for users to install expensive software on their machines.
- It provides total autonomy from a geographic location as spatial data and GIS software will be accessed via internet.
- It is flexible 24/7 access of clients to the server and fast performance of complex spatial operations on the server machine.
- Provides a collaborative virtual learning environment that is shared by students and the instructor.

# Objective of this virtual learning environment

a. To allow interaction between student and instructor, student and computer, and student and student using a mix of synchronous and asynchronous communication tools,

b. To set a liberated online learning environment where students have access to a collection of passive and active multi-media tools,

c. To allow students access to a mixed Web-facilitated architecture that stimulates their cognitive geographic skills and provides hands-on experience in using GIS.

# SETTING VIRTUAL LEARNING TOOLS

- Multi-tier approach shall be adopted to develop the virtual entities

- The tools shall allow learners:

a. Access the core content e.g. reading material, Power Point slides, digital lectures streamlined in RealTime, library of ARCGIS video clips etc

b. Communicate and share information via message boards, chat rooms, bulk e-mails, phone

c. Access services e.g. calendar, checklist of required tasks (e.g. GIS assignments), grading

d. Access the general collaborative virtual study environments

# Setting of Virtual GIS Computer Laboratory

- Implementation of this lab component requires the solving of traditional and topical GIS problems (e.g., map projections)

- Detailed step-by-step instructions of GIS-based spatial operations shall be provided to students to guide them.

- At the end, students will have to answer 3-5 questions about what they have just learnt

- The lab shall be accessed via a Windows Multipoint Server mountained a very powerful Dell platform.

- ArcGIS 10.2, QGIS, SAGA GIS and spatial datasets shall be installed in the lab

- Remote Desktop Web Connection shall consists of an ActiveX client control and sample Web pages.

# Sequence of events that take place with ActiveX Client Control

- A Web browser (e.g. Internet Explorer) downloads a configuration file (.cab) that contains information required by the client to connect to the server (i.e. the virtual GIS computer).

- After downloading, IE decompresses the .cab file and installs the ActiveX Client Control in IE's default location for downloaded controls on the target computer.

- The default connection page appears asking the student for server, logon, and connection information. A password protection is build into the system to prevent access from nonregistered students.

- The Remote Desktop is in the Web page and Windows logon screen appears.

- Upon successfully logging into the virtual GIS computer lab, the student starts performing tasks (e.g., open the ArcGIS software to work on assignments).

- The student's requests are sent to the server, processed and the response is sent back to the student.

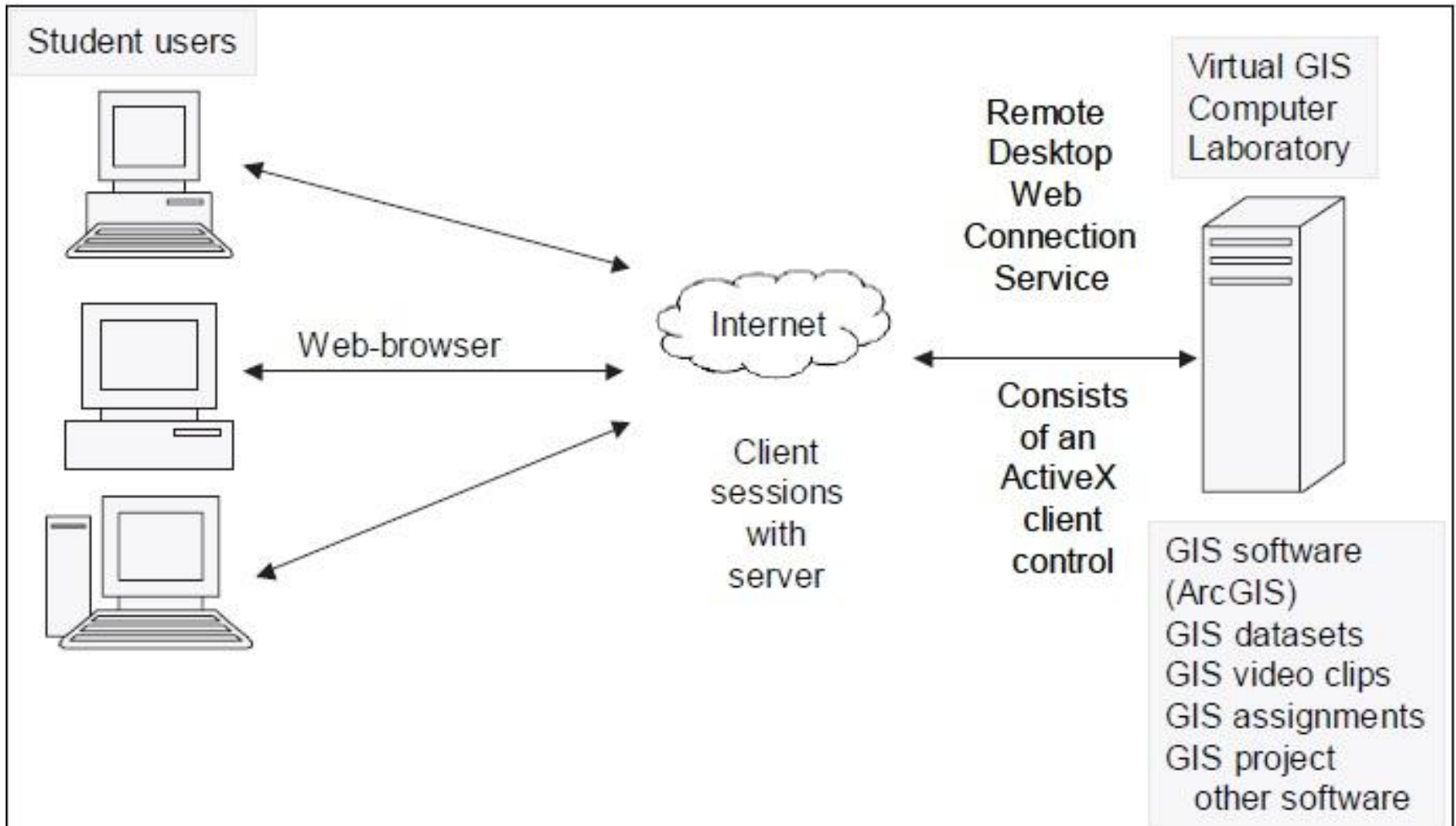**Access to Virtual GIS Computer Lab is password controlled**

**Fig. 3. Virtual GIS Computer Laboratory architecture**
**Adopted from: Grunwald et. al. (2007)**

# Advantages of Virtual Learning Environment

- Virtual entities can be customized for different learners. E.g. same material about one topic can be given in form of reading material, Power Point slides etc to reach students with different learning styles.

- The core content tools can easily be updated since they are organized in form of learning objects using a hierarchical setup.

- It promotes flexibility in the manner students and instructors interact.

- No physical presence on campus is required.

- Is accessible 24/7

- Students not required to install expensive GIS software on their local client machines.

- No need to download and upload large GIS files

# Limitations of Virtual Learning Environment

- Need high-speed Internet connection between the client and server machine to optimize viewing of maps and graphics

- The highly interactive, computerized online environment may be a challenge to some students

- It requires more time commitment to develop a virtual learning environment (i.e. content development, programming, and extensive testing)

# Conclusion

- This is a simple, affordable, and versatile innovative architecture for GIS computer laboratory

- It is a flexible, collaborative virtual learning environment for ODL for MZUNI

- A hybrid approach will complement virtual entities of core content, service, and communication tools with a virtual GIS computer laboratory.