



TECHNICAL INNOVATION OF GEOGRAPHY WITH GIS IN HIGHER EDUCATION

Prakash Vir Singh, Ph. D.

Asst. Professor Deptt. of Geography, Tilak P.G. College, Auraiya, U.P

Abstract

The innovative geographical smart class system emphasises the use of technology tools as an important aid in learning and teaching: computers are the main instruction (teaching) tool. Significantly, the integration of ICT (Information and Communication Technology) in teaching has given greater priority to Science, Mathematics, and English. Therefore, Geography has become what students perceive as a 'dry' subject with little use of technology. Unlike India in developed countries Geography receives more attention and has become a key subject at both the primary and secondary level; as a result, Geographic Information Systems (GIS) are widely accepted and integrated into the Under Graduation and Post Graduation Geography curriculum. However, the integration of GIS in Geography education in India is still regarded as a myth, for reasons of lack of ability, human resources, ground facilities, and ICT provision. Thus, this article will discuss the potential to integrate GIS in an Indian Higher Education System, which is well known for being the most sophisticated and well-equipped with ICT in the country. A content analysis was performed based on articles from local and foreign publications regarding the integration of GIS in Geography teaching. The content analyses, which include articles, theses and conference papers, discuss the opportunities to integrate GIS in teaching Geography. The analysis shows that innovative smart classes in India have adequate ICT facilities and well-trained human resources for GIS. Thus, a plan for integrating GIS in Geography education is not a myth and will become a reality if the Indian Ministry of Human Resource and Development is ready to implement it at grass root level.

Keywords: *Geographic Information System (GIS), Smart Classes, Geography Curriculum*



Scholarly Research Journal's is licensed Based on a work at www.srjis.com

Introduction to GIS

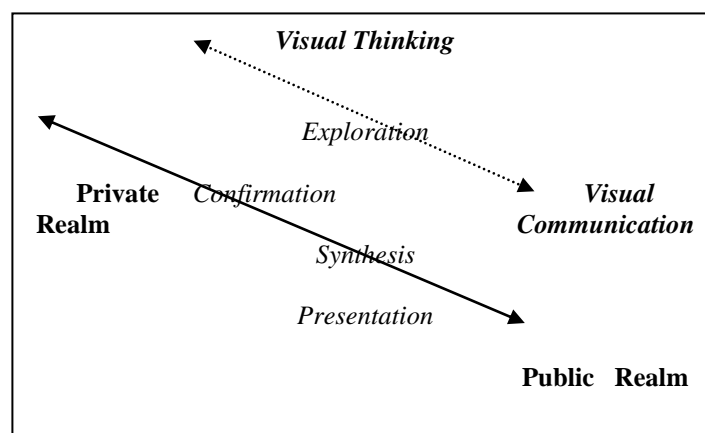
Geographic information (i.e., land information, spatial information) is information that can be associated with a place name, a street address, section/township, a zip code, or coordinates of latitude and longitude. A "geographic information system" (GIS) is a computer-based tool that allows us to create, manipulate, analyze, store and display information based on its location. GIS makes it possible to integrate different kinds of geographic information, such as digital maps, aerial photographs, satellite images and global positioning system data (GPS), along with associated tabular database information (e.g., 'attributes' or characteristics about

geographic features). GIS allows us to examine and analyze geographic information at different levels of detail or from different perspectives. Then, it enables us to customize the display of your maps and analyses for presentation to particular audiences. GIS have been used in a multitude of applications as ‘scientific tool[s] in natural resource management (forestry, agriculture, conservation), cave and karst research, environmental management, health and environmental health research, mining and petroleum research, hazards management and Earth science, among others’ (Walker, 2004, p. 3). Therefore, the skills and knowledge students acquire through GIS use in school may also enhance their future career prospects. Increasingly, schools around the world are beginning to see the possibilities of using GIS for teaching and learning in not just Geography, but also in subjects like History, Botany and Environmental Chemistry. Some students have also used GIS in their community service projects (e School News, 2006). According to Baker (2005, p.44), GIS is ‘emerging as an instructional technology for supporting contextually rich student learning’.



Scientific Visualisation and Inquiry based Learning with GIS

One of the main strengths of using GIS in education is that they enable students to use maps and their databases to engage in ‘scientific visualisation’. Scientific visualisation refers to the process of interaction, manipulation and expression of information by the student.



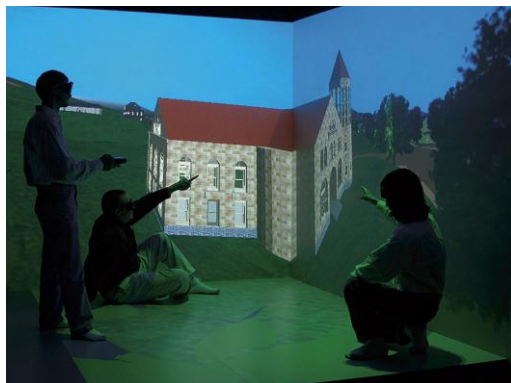
(Figure – 1)

Visualisation as a tool of scientific research. (Adapted from DiBiase, 1990 in MacEachren and Taylor 1994, p. 3).

As seen in Figure 1, visualisation can be used as a tool for scientific research. When students use map-based visualisation as learning tools, they gain a rich, immersive understanding of the concepts related to the data being explored, and also the skills in organising and communicating information in our data-rich environment. Students, who travel up and down the range of visualisation methods to constructively explore, discover and hypothesise on various scientific theories and concepts will no longer be passive recipients of information, but active discoverers and constructors of knowledge. The scientific visualisation concept matches well with the inquiry-based learning approach recommended for the Science curriculum. This approach is also applicable to the teaching of human and physical geography, which are fundamentally regarded as social and environmental sciences respectively. In addition, his anchoring of geographical data in real-life phenomena provides many possibilities for implementing problem-based learning approaches in rich, authentic, educationally productive contexts.

Reasons for using GIS in Teaching and Learning

GIS have been identified as one of the 21st Century Tools for Communication, Information Processing and Research which will help to develop student abilities in investigating, evaluating, integrating, creating and analysing issues and information at various scales and locations (Partnership for 21st Century Skills, 2004). Therefore, GIS use in education will develop students' information and media literacy, preparing them well for the digital age. The unique nature of inquiry-based learning through GIS is the focus on spatial characteristics – location. The foundation of geographical thinking is to know “where something is, how its location influences its characteristics, and how its location influences relationships with other phenomena.”



(Environmental Systems Research Institute - ESRI, 2003). GIS enables the teacher to employ learner centred approaches to delivering the curriculum, as compared to traditional didactic

modes of delivery. By using authentic data for realistic outcomes, effective and engaged learning can be achieved. Through GIS-enabled inquiry, students not only build knowledge related to the curriculum; they also develop critical thinking skills in managing, manipulating, querying, constructing and presenting information. Research findings on the use of GIS in education have been encouraging. For example, Baker and White (2003, p. 243) have found that there were 'significant improvement in attitudes toward technology, self-efficacy toward science, and modest, yet significant, improvements for geographic data analysis for [senior secondary] students who used GIS' in a 'two week Project Based Learning unit'. In addition, Pang (2001, p. 5) found that College students who had experienced dynamic and interactive visualisations through a GIS had 'positive educational effect, especially in terms of creative and visual thinking'.

Framework for using GIS for teaching and learning (ESRI, 2003).

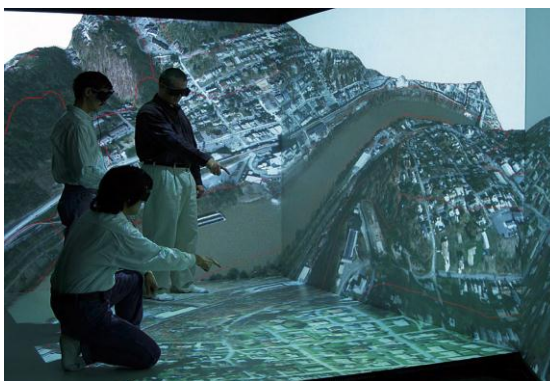
The cycle of Geographic Inquiry is a simple and useful 5-step framework for teachers to use when planning to implement GIS in the classroom:

1. Ask geographic questions
2. Acquire geographic resources
3. Explore geographic data
4. Analyse geographic information
5. Act upon geographic knowledge
6. Provide an interdisciplinary and integrated approach to GIS.
7. Develop critical and analytic skills for problem solving through the use of GIS.
8. Enhance students' ability to undertake effective decision making.
9. Develop skills in evaluation, application, and management of information systems.
10. Provide a sound understanding of the role of spatial data in decision-making processes.
11. Understand the business, social, and environmental implications of GIS.
12. Provide students with a range of skills and knowledge to undertake a range of GIS-related jobs.
13. Help students adapt to the rapid changes taking place in information technology and be able to respond flexibly and positively.

Two Possible Models of GIS use in Colleges:



1. Data Exploration Approach – This is recommended for initial low-cost adoption of GIS for teaching and learning. Using free or low-cost GIS software and data, students can be tasked to explore the geographical information in a guided manner (e.g. using an inquiry-based or problem-based approach), and deduce patterns and relationships between various phenomena, and generate hypotheses on causes and effects. They will thus gain conceptual understanding and real-world knowledge from an authentic, evidence-based ‘ground-up’ approach. Teachers and students will also gain familiarity with the various (Web GIS integrates all types of information, organizing GIS functionalities. For example, Students may and sharing the work both internally and on the open web) explore information on indicators of low standards of living (low income, illness, high crime rate) in different parts of a city. They could then hypothesise the interrelationships between the various phenomena and their locations, and discuss possible problems and solutions.



2. Fieldwork and Analysis Approach – This is recommended for teachers and students who have experienced the Data Exploration Approach and are already comfortable with using GIS. Questions and issues may arise from the Data Exploration approach, or from class discussions. Teachers may then guide students to embark on an investigative project involving fieldwork data collection and analysis. This approach may require the use of GIS with data creation, manipulation and analysis capabilities. Therefore, some additional cost may be incurred for software and hardware purchases. For example, students could find out the location and causes of pollution in and around the college environment. Using the GIS as a data collation and analysis platform, students could use data-loggers to collect data on air,

water, land, heat and noise pollution from the college neighbourhood and relate them to nearby land uses (e.g. roads, factories, shopping centres, etc.) and analyse the possible problems and solutions.



GIS software and data

Free GIS software with basic functions can be easily downloaded from the Internet and implemented in computer labs or classrooms. Another viable approach is to use Internet-based GIS which only require users to have web browsers like Internet Explorer or Firefox. Google Earth software combines satellite images with geographical information to provide users with a data-rich, intuitive and interactive platform in order to explore various phenomena at different locations on Earth. GIS software with advanced editing and analysis capabilities for various operating systems and platforms can be purchased from companies like Environmental Systems Research Institute (ESRI), Asia GIS and Intergraph etc. GRASS GIS is a free and Open Source GIS with high-level functionalities. Large amounts of GIS data are available for free or low-cost download over the Internet. In addition, GIS data is usually conveniently packaged with each commercial software purchase. Therefore, current developments in GIS have led to an ideal educational environment for teachers to facilitate the development of student's knowledge and skills in different subject areas through the use of GIS technology.

Questions that should be asked before using GIS for Teaching and Learning:

The following questions can be used by teachers to guide their planning of the use of GIS for teaching and learning:

- (a) How can students' learning be scaffold through GIS use?
- (b) How does the usefulness of GIS technology help teachers to facilitate effective and engaging learning experiences for students in various subjects and topics?
- (c) Has sufficient time been factored-in for teachers and students to learn the basic skills of using GIS software?
- (d) Where can the required data are obtained? If students are involved in searching for and creating data, what is the value-add of them doing so?

(e) Have there been adequate preparations in terms of time, scaffolding for students and equipment for students to collect data?

Conclusion

GIS technology provides many opportunities for teachers to implement learner-centred approaches for various geographic subjects in an authentic, engaging, integrated and holistic manner. Together with the increasing availability of affordable GIS software and data, the time is ripe to bring GIS-enabled teaching and learning approaches into the classroom environment.

Bibliography

- Aladag, E. (2010). *The effects of GIS on students' academic achievement and motivation in seventh grade social studies lessons In Turkey. International Research in Geographical and Environmental Education*, 19 (1), 11-23.
- Bednarz, S. W. (2004). *Geographic information systems: A tool to support geography and environmental education? Geo Journal*, 60 (2), 191-199
- Beuschel, W., Graiser, B., & Draheim, S. (2003). *Communication needs of online students. In A.K. Aggarwal, Web-based education: Learning from experience (pp. 203-222). Hershey: Idea Group.*
- Demirci, A., & Karaburun, A. (2009). *How to make GIS a common educational tool in schools: Potentials and implications of the GIS for teachers book for geography education in Turkey. Ozean Journal of Applied Sciences*, 2(2), 205-215.
- Fargher, M. (2012). *United Kingdom: Realizing the potential for GIS in the school geography curriculum. In Milson A.J, Demirci. A & Kerski. J (Eds.), International Perspectives on Teaching and Learning with GIS in Secondary Schools. (pp. 299-304).*
- Milson, A. J., & Earle, B. D. (2008). *Internet-based GIS in an inductive learning environment: A case study of ninth-grade geography students. Journal of Geography*, 106 (6), 227-237.
- Nordin Sakke. (2006). *Implementation of GIS in geography education in Sabah. Environmental Geography and Education (pp. 109-122). Tanjung Malim: UPSI.*
- Rosilawati, N., Syra, Goh, Tan. (2011). *Empowering teaching and learning of geography by using web-based GIS application as a teaching tool. Paper presented at the International Education Technology Conference, Istanbul.*
- Shin, E. K. (2006). *Using geographic information systems (GIS) to improve fourth graders' geographic content knowledge and map skills. Journal of Geography*, 105 (3), 109-120.
- West, B. A. (2003). *Student attitudes and the impact of GIS on thinking skills and motivation. Journal of Geography*, 102 (6), 267-274.
- Wiegand, P. (2003). *School students' understanding of choropleth maps: Evidence from collaborative map making using GIS. Journal of Geography*, 102 (6), 234-242.