Past, present and future of GIS education: experiences from Australia and Europe

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Content

- Intro - GIS into tertiary education
- Multimedia tools in GIS teaching and learning
- GISWEB – a self learning GIS tool
- Current resources for GIS learning and teaching
- GIS competencies in the European Higher Education Area (EHEA)
- Final remarks
The uptake of GIS in tertiary education

- Late 1980’s and early 1990’s – informal training courses
- Late 1990’s - GIS subjects in university under and postgraduate studies (Geography and Engineering mainly)
- Early 2000’s – GIS courses in all Earth Sciences and Civil, Geodetic and Environmental Engineering
- Today – GIS is ubiquitous (Public Health, Management, Business, Criminology…)

Lack of agreement among universities
Unstructured contents
Multimedia tools in GIS teaching and learning

Past

ArcDEMO

Virtual Campus

GISTutor

ESRI

GISWEB

4/26

Present

GISTutor.com (Vancouver)
GISWEB – a self learning GIS tool

  - Purpose
  - Implementation
  - Content

  - Translation
  - Practical modules
  - Evaluation

www.geogra.uah.es/gisweb
At The University of Melbourne GIS attracts students from

- Geomatics
- Computer science
- Archaeology
- Geography
- Architecture
- Earth science
- ...

GISWEB – context
Aim

To enhance, rather than replace, traditional GIS learning models such as lectures, tutorials and practical assignments + Self-paced learning.

Our expectations:

- In-lecture tool
- Improved:
  - Access to learning
  - Productivity
  - Quality of student learning
  - Student attitudes to learning
GISWEB - implementation

- Consultation with University of Melbourne’s Multimedia Education Unit
- Software adopted
  - Macromedia Director
  - Flash and Shockwave
  - HTML
  - Java scripts
GISWEB - content

- Modules
  - Introduction to geographic information systems
  - Vector overlay processes
  - Raster analysis
  - Terrain analysis
  - Spatial data entry
  - Neighbourhood operations
  - Buffers
  - Line generalisation algorithms
  +
  - Glossary
  - References

https://geogra.uah.es/patxi/gisweb/menu.html

This suite of learning tools is designed for use by students currently undertaking one or more Geographic Information Systems (GIS) courses at The University of Melbourne. Some general knowledge regarding GIS is assumed by each of the modules. Please consult your GIS lecturer if you are unsure about any of the content.

The modules have the following structure: theory, examples, interaction, test with feedback.

There is a glossary and list of references available also.

Select the module of your choice to begin:

- introduction to GIS
- vector overlay processes
- raster analysis
- terrain analysis
- glossary
- feedback form
- spatial data entry
- neighbourhood operations
- buffers
- line generalisation algorithms
- references
- site map
- Core GIS concepts with a particular emphasis on spatial algorithms
- Concepts where students experienced difficulties without specific visual or interactive support
- Modules components:
  - Theory
  - Algorithms
  - Worked examples
  - Self-paced revision tests
GISWEB – The Spanish version

- Final year projects
  - 2002:
    - Prototype (2 modules)
    - Evaluation
  - 2004:
    - Full translation
    - Practical exercises
- Usage
  - Env. Sciences
  - Geodetic Engineering
  - Master TIG
  - Latin America

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GISWEB – Practical exercises

- ArcGIS – proprietary software
- gvSIG – open (and free) software
### GISWEB – Evaluation

#### Tool evaluation

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The instructions to use the Neighbourhood Operations site were clear</td>
<td>AS: 50</td>
</tr>
<tr>
<td></td>
<td>A: 50</td>
</tr>
<tr>
<td></td>
<td>N: 0</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>2. The web pages were easy to navigate</td>
<td>AS: 39</td>
</tr>
<tr>
<td></td>
<td>A: 61</td>
</tr>
<tr>
<td></td>
<td>N: 0</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>3. General layout/design of Neighbourhood Operations site was well organised</td>
<td>AS: 33</td>
</tr>
<tr>
<td></td>
<td>A: 61</td>
</tr>
<tr>
<td></td>
<td>N: 6</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>4. The textual information effectively conveyed the concepts and applications of Neighbourhood Operations</td>
<td>AS: 28</td>
</tr>
<tr>
<td></td>
<td>A: 56</td>
</tr>
<tr>
<td></td>
<td>N: 6</td>
</tr>
<tr>
<td></td>
<td>D: 11</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>5. Graphics and animations were effective in illustrating the concepts and applications of Neighbourhood Operations</td>
<td>AS: 44</td>
</tr>
<tr>
<td></td>
<td>A: 50</td>
</tr>
<tr>
<td></td>
<td>N: 6</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>6. Interactivity (user control) was useful for learning the concepts and applications of Neighbourhood Operations</td>
<td>AS: 56</td>
</tr>
<tr>
<td></td>
<td>A: 39</td>
</tr>
<tr>
<td></td>
<td>N: 6</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>7. The ‘Questions with Feedback’ component was adequate for testing concepts</td>
<td>AS: 33</td>
</tr>
<tr>
<td></td>
<td>A: 61</td>
</tr>
<tr>
<td></td>
<td>N: 6</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>8. The instructions and use of the interactive lessons were clear</td>
<td>AS: 39</td>
</tr>
<tr>
<td></td>
<td>A: 61</td>
</tr>
<tr>
<td></td>
<td>N: 0</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>9. Time needed to load the Shockwave movies (lessons) was acceptable</td>
<td>AS: 6</td>
</tr>
<tr>
<td></td>
<td>A: 39</td>
</tr>
<tr>
<td></td>
<td>N: 44</td>
</tr>
<tr>
<td></td>
<td>D: 11</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>10. The level of detail in the lessons was adequate</td>
<td>AS: 6</td>
</tr>
<tr>
<td></td>
<td>A: 78</td>
</tr>
<tr>
<td></td>
<td>N: 17</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>11. The level of control over the interactive lessons was adequate</td>
<td>AS: 33</td>
</tr>
<tr>
<td></td>
<td>A: 67</td>
</tr>
<tr>
<td></td>
<td>N: 0</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
<tr>
<td>12. These web pages would help my understanding of Neighbourhood Operations</td>
<td>AS: 28</td>
</tr>
<tr>
<td></td>
<td>A: 72</td>
</tr>
<tr>
<td></td>
<td>N: 0</td>
</tr>
<tr>
<td></td>
<td>D: 0</td>
</tr>
<tr>
<td></td>
<td>DS: 0</td>
</tr>
</tbody>
</table>

**KEY**

**Notes:** Agree Strongly (AS); Agree (A); Neutral (N); Disagree (D); Disagree Strongly (DS).

**Source:** After Nascarella and Urquhart (1999).
GISWEB – Evaluation

- Learning outcomes evaluation

<table>
<thead>
<tr>
<th>Program</th>
<th>Year</th>
<th>Students</th>
<th>Average age</th>
<th>% women</th>
<th>Previous GIS knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Sciences</td>
<td>Second</td>
<td>38</td>
<td>19</td>
<td>65.79</td>
<td>Nil (100%)</td>
</tr>
<tr>
<td>PhD Geography</td>
<td>First</td>
<td>10</td>
<td>30</td>
<td>64.29</td>
<td>Some (57.14%)</td>
</tr>
<tr>
<td>Geodetic Engineering</td>
<td>Fourth and fifth</td>
<td>14</td>
<td>26</td>
<td>56.25</td>
<td>Some (87.5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Student group</th>
<th>Number of students GISWEB</th>
<th>Mark obtained in test</th>
<th>Number of students traditional lecture</th>
<th>Mark obtained in test</th>
</tr>
</thead>
<tbody>
<tr>
<td>First year</td>
<td>38</td>
<td>5.5</td>
<td>37</td>
<td>3.5</td>
</tr>
<tr>
<td>Engineers</td>
<td>14</td>
<td>7.49</td>
<td>10</td>
<td>7.17</td>
</tr>
<tr>
<td>PhD</td>
<td>10</td>
<td>7.3</td>
<td>12</td>
<td>6.3</td>
</tr>
</tbody>
</table>
1. **Software** – availability of free and open source (gvSIG, qGIS...)
2. Availability of online **tutorials** (youtube and others)
3. Availability of online **literature** - lecture notes, books, articles...
4. Availability of well documented **data** – SDI (Copernicus, IGN...)
5. **Mobile devices**
6. Increased **integration of technologies** (communications, 3D –CAD-, video editing, multimedia –interactive tools-, virtual and augmented reality...)
7. **Social networks and communities** (ie tweeter, OpenStreetMaps...)
8. **New functionality** in Cartography (navigation systems, location based services, early alert systems, games –F1 racing, Pokemon Go... –)
Current resources for GIS teaching and learning

3D visualization exercise

2002

2006

2015
Issues

1. Uncertain value
2. Innovations speed - Obsolescence
3. Digital gap
4. Connection speed (lesser today)
5. Developers skills
6. Costs
7. Ongoing updates and maintenance
GIS competencies in the European Higher Education Area (EHEA)

- Background
- Aim
- Method
- Results
- Discussion
Background

- The European Higher Education Area focus on competencies
- University Consortium for Geographic Information Science (UCGIS) – Curricula
- Geospatial Technology Competency Model – Hierarchized model
- Professional profiles (data analyst, programmer, cartographers...)
- In Spain: White Books (on Geography and Land Planning...)
Aim

Given the new conditions established under the umbrella of the EHEA...

and

The unstructured evolution of the uptake of GIT in tertiary education...

- ...to offer an insight and a proposal for fundamental GIS-related competencies to be considered in tertiary education (Degree, Master and PhD)
Approach

Participatory

- GITechnologies academic staff at the University of Alcalá (9 full time staff)
  - Three brainstorming sessions
- 200 GITechnologies Spanish academics and professionals
  - Online questionnaire
Resultados

Nivel de complejidad

<table>
<thead>
<tr>
<th>Competencias propuestas</th>
<th>Grado de adquisición</th>
<th>Niveles universitarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. Conocer / aplicar los métodos para la elaboración de cartografía temática básica</td>
<td>GRADO</td>
<td>MASTER</td>
</tr>
<tr>
<td>V.1 Conocer los tipos de clasificación de la variable temática. Límites de clase.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>V.2 Conocer las variables visuales disponibles y sus propiedades perceptivas (J. Bertin)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.3 Utilizar las variables visuales en función de la escala de medida de la variable temática y la geometría de los objetos cartográficos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.4 Conocer y aplicar los principios de la Cartografía univariada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.5 Conocer y aplicar los principios de la Cartografía multivariada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.6 Capacidad de concebir y elaborar mapas temáticos básicos</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GIS competencies in the EHEA
## Results

### GIS competencies in the EHEA

<table>
<thead>
<tr>
<th>GRADO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

### I. Definir/identificar componentes y aplicaciones de los SIG

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I.1</strong></td>
<td>Definir los Sistemas de Información Geográfica (SIG) e identificar sus componentes.</td>
</tr>
<tr>
<td><strong>I.2</strong></td>
<td>Conocer los principales hitos de la historia de los SIG.</td>
</tr>
<tr>
<td><strong>I.3</strong></td>
<td>Identificar funciones y campos de aplicación de los SIG.</td>
</tr>
<tr>
<td><strong>I.4</strong></td>
<td>Identificar la naturaleza y las partes de un problema territorial complejo como paso previo a la selección de datos y procedimientos en el SIG.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resultado encuesta</th>
<th>Nuestra propuesta</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Grado de adquisición**

1. No abordado en este nivel
2. Conseguido de forma inicial (fundamentos)
3. Conseguido parcialmente (profundización)
4. Plenamente conseguido
5. Se asume ya conseguido en niveles inferiores
Discussion

- Further evidences needed
- Discussion forum
- Diversity of users, degrees, backgrounds
- Still... a highly useful exercise
  - Insight on what is taught, when, to whom and for what purpose
Final remarks

- GIS teaching and learning will continue evolving and adopting newer technologies
- What the future of GIS education is going to look like?
  - Divergence (programmers, analysts, users...)
  - Real time, augmented and virtual reality
  - Multisensorial – sound, feel, touch, smell...
  - et...

?
Big thanks to GISWEB people:

- Ian Bishop
- Gary Hunter
- Andre Zerger
- Fiona Ellis

Melbourne team

- Ian Bishop
- Gary Hunter
- Andre Zerger
- Fiona Ellis

Alcalá FYP Students

- Isaac Francés
- Jimena Martínez
- Juan Salinas

...and to “competencies” team:

- Víctor Rodríguez
- Inmaculada Aguado
- Francisco Aguilera
- Joaquín Bosque
- Emilio Chuvieco
- Montserrat Gómez
- Javier Salas
- M. Jesús Salado

FYP Students

- Joianna Nascarella
- Karen Urquhart

All users around the World

Every colleague who answered the questionnaire

Un grand merci à vous tous pour votre attention