

GIS AND DIGITAL CARTOGRAPHY IN SPANISH HIGHER EDUCATION

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1 Introduction

Increasing demand for the use of emerging digital technology for cartography and for spatial analysis and facilities management—GIS analysis—has prompted the creation of many courses, seminars, books, and practical teaching materials by the Spanish higher education system. More concretely, it has been observed that the number of GIS courses in Spain has tripled between 1993 and 1994. This short poster paper summarizes and updates recent surveys (i.e. [1, 2, 3, 4]) of the educational offerings at more than 30 sites in Spain. The paper highlights a critical aspect of GIS education in Spain: the unemployment rate has hovered between 15-20% for the past two years while the digital cartography/GIS market has been growing steadily and cannot find enough properly trained people. This has caused a rise in interest in attending short-term, practical GIS courses aimed at employability rather than longer, more theoretical courses on the same topics. Thus, many of the students attending postgraduate "short courses" are unemployed (or under employed) professionals who have already completed 4 or 5-year university degree programs and possess certain work experience, but who are looking for retraining or continuing education. This is a curious trend, which affects the nature of all GIS and digital cartography courses and course materials being produced in Spain. Readers should note that we generally speak of digital cartography and GIS as one single entity, as they are almost always integrated into the same academic or short-course curricula.

2 Recent Results

A study by Comas and Pujol ([1]) solicited information from 54 university centers known to offer some sort of GIS education and research. Of the 23 questionnaires returned 28 courses were identified. As illustrated in Figure 1, the majority of the courses were at the 4-5 year academic program (career) level, while 7 were at the doctoral (Ph.D.) and 4 at the postgraduate (continuing education) levels. Courses were offered in a wide range of academic disciplines, from Surveying to Ecology, but the vast majority are found in Geography departments. Curiously, there appears to be little activity within the Computer Science departments as far as experimentation with spatial data handling algorithms and data structures. Figure 2 indicates that the courses reported in 1993 tended toward practical content rather than being purely theoretical. Figure 3 illustrates the GIS software most commonly used in the courses reported.

It should also be noted that GIS has a relatively short history in Spain [2,6], with the first courses having started in about 1990. Therefore, we find that most GIS courses are at the introductory level, and courses on more detailed technical issues are rare, as are courses on system design and project management issues. We also find that Spain lacks research consortia and networks whereby interdisciplinary groups work toward common goals, as in the American NCGIA or the Regional Research Labs (RRL) of the United Kingdom.

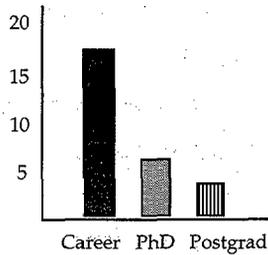


Figure 1. Typology of GIS courses, 1992-93 (after [1])

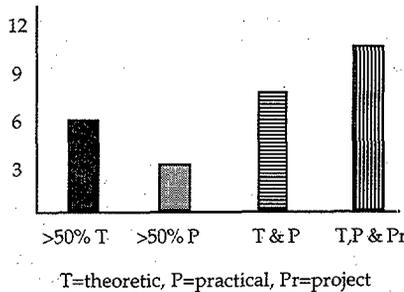


Figure 2. Theoretic/practical breakdown of GIS courses (after [1])

3 Current Situation

Although results from an updated survey are not available at press time, we can speculate that the number of GIS and digital cartography courses has at least doubled, and perhaps tripled between 1993 and 1995. Some growth is expected at the career level of courses, within the standard academic curricula, however we note that the number of possible academic departments which might offer GIS is rather limited. The majority of growth is in the area of postgraduate courses, which are between 20 and 300-plus hours in duration

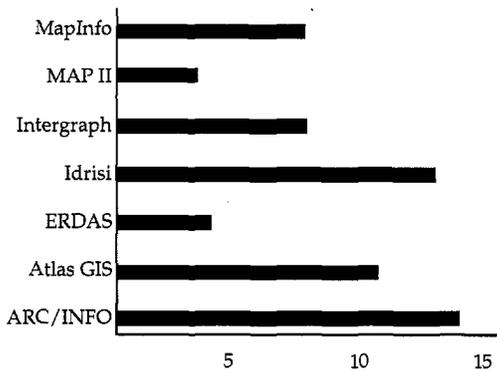


Figure 3. Most commonly used GIS software. Also mentioned: ArcCAD, Ascodes, ComGrafix, Demeter, Genamap, Ilwis, MacGlobe, MAP, TransCad, SPANS, System9 (after [1])

and are aimed at recent graduates and working (or unemployed) professionals in land-related specialties. These courses are more practical extensions to the fundamental courses already offered in the curriculum, and they offer the opportunity for academic departments to reach out to the community, make industrial contacts, and earn extra income as well. The latter should not be trivialized, as GIS/digital cartography laboratories and their annual maintenance fees are a serious economic burden on State supported universities.

An example of these postgraduate courses is one at the Universitat de Girona, which offers both theory and practice in GPS, aerial photography, remote sensing, and GIS during three months part-time (100 hours). Fifteen professors from 11 institutions participate, and practical exercises are carried out using a classroom of 486 PCs. Student composition for the most recent course was the following: 15 geographers, 3 architects, 1 draftsman, 1 surveyor, 1 computer scientist, 1 geologist, and 1 chemist. The cost of the course was 130,000 pesetas (approximately \$1000) with the possibility of scholarships for students not currently employed. Another example is the series of short courses offered by the Universidad Autónoma de Madrid ([3]). These courses are of two weeks duration and focus on cadastral cartography with emphasis on the requirements of the Spanish national cadastre, implemented using ARC/INFO.

At least 3 Spanish institutions have offered, or are offering, postgraduate courses of 300 or more hours, roughly equivalent to the angloamerican Masters degree. The Universidad Politécnica de Madrid offered a few years back a 500-hour Master in GIS course, based primarily on surveying sciences and techniques and costing 750,000 pesetas. Unfortunately, this course has not been repeated. The Universidad de Alcalá de Henares (Madrid), Department of Geography, has for three years running offered a course on GIS, remote sensing and other geographic analysis techniques. Finally, and most recently, the

Universidad Complutense de Madrid is offering a 300-hour GIS course (official university Masters degree) partially financed by the national unemployment agency and, thus, available to unemployed students at low or no cost. These long-term courses should not be confused with the many dubiously named "Masters" which are cropping up in Spain, some of which are only brief training courses on specific software ([5]).

Another important topic, which we will not address in detail due to space limitations, is the increased participation of Spanish university researchers in European Union scientific and R&D projects. This participation is based perhaps more on the fact that much of the nation is classified "Objective 1" (Economic Production below 75% of the European average) than on cutting-edge scientific know-how.

4 Textbooks

A major revolution in the field of GIS and digital cartography education in Spain has been the recent publication of several textbooks on a variety of related topics. Most of these books are, we should note, of an introductory nature coinciding with the current demand among students and teachers. The following list was extracted with permission from Professor Javier Gutiérrez ([7]).

4.1 General textbooks

- Bosque, J., 1992. *Sistemas de Información Geográfica*. Madrid: Rialp.
Calvo, M., 1993. *Sistemas de Información Geográfica digitales: Sistemas geomáticos*. Vitoria: Instituto Vasco de Administración Pública and Fundación EUSKOIKER.
Comas, D. and Ruíz, E., 1993. *Fundamentos de los Sistemas de Información Geográfica*. Barcelona: Ariel.
Guimet, J., 1992. *Introducción conceptual a los Sistemas de Información Geográfica*. Madrid: Estudio Gráfico Madrid.
Gutiérrez, J. and Gould, M., 1994. *SIG: Sistemas de Información Geográfica*. Madrid: Síntesis.

4.2 GIS Concepts

- Cebrian, J.A., 1992. *Información Geográfica y Sistemas de Información Geográfica*. Santander: Universidad de Cantabria.
Cebrian, J.A., 1994. *GIS Concepts*. Cáceres: Departamento de Geografía y Ordenación del Territorio, Universidad de Extremadura.

4.3 Digital Terrain Modeling

- Felícísimo, A.M., 1994. *Modelos digitales del terreno*. Oviedo: Pentalfa.

4.4 Practicals/Exercises

- Bosque, J., Escobar, F.J., García, E., and Salado, M.J., 1994. *Sistemas de Información Geográfica: Prácticas con PC ARC/INFO e IDRISI*. Madrid: Ra-ma.
Seguí, J.M. and Ruíz, M., 1995. *Prácticas de análisis espacial y SIG*. Barcelona: Oikos-tau.
Universidad de las Islas Baleares, 1992. Translation to Spanish of *Understanding GIS: The ARC/INFO Method*, ESRI: Redlands, Calif., USA.

4.5 GIS applications (in Spain)

Gould, M. (ed.), 1994. *El uso de los Sistemas de Información Geográfica*. Madrid: ESRI-España Geosistemas.

4.6 GIS Terminology Dictionaries

AESIG, 1992. *Diccionario glosario de términos SIG*. Madrid: Estudio Gráfico Madrid.

González, R., 1994. *Diccionario de términos SIG*. Madrid: Consejo Superior de Investigaciones Científicas.

Otero, I. and others, 1995. *Diccionario de cartografía, topografía, fotogrametría, teledetección, SIG, GPS, y modelos digitales de terreno*. Madrid: Ediciones de las Ciencias Sociales.

5 Conclusion

In the space allocated to poster papers we cannot properly discuss the depth and breadth of GIS and digital cartography in Spanish higher education, but we hope that this has been a useful glance at the development of this field. Key points to remember are, 1) the technology arrived to Spain only 5 or 6 years ago; 2) the GIS market has been growing steadily despite almost 3 years of economic crisis; 3) unemployment in Spain has hovered around 15-20% during this same period, leading to increased interest in practical postgraduate courses which emphasize employability; 4) Spaniards are participating in increasing numbers in European Union macroprojects, partly because much of Spain is classified "Objective 1"; 5) Spanish-language GIS and digital cartography textbooks have been an important impulse in the growth of the field.

6 References

- [1] Comas, D. and Pujol, P., 1993. La formación de profesionales de los Sistemas de Información Geográfica en España. *Catastro* No. 18, October 1993, pp. 52-60.
- [2] Comas, D. and Ruiz, E., 1993. *Fundamentos de los Sistemas de Información Geográfica*. Barcelona: Ariel.
- [3] Espiago, F.J., 1992. La enseñanza de los SIG en las universidades de Madrid, *Boletín de la Asociación Española de SIG*, No. 3, pp. 9-10.
- [4] Gould, M., 1992a. Spain's GIS Education Centres Prospering, *GIS Europe*, March 1992, pp. 14-16.
- [5] Gould, M., 1992b. Spain Awaiting Influx of 'Masters in GIS', *GIS Europe*, November 1992, pp. 18.
- [6] Gutiérrez, J. and Gould, M., 1994. *SIG: Sistemas de Información Geográfica*. Madrid: Síntesis.
- [7] Gutiérrez, J., forthcoming. GIS in Spain. Chapter in 1996 *International GIS Sourcebook*, GIS World: Fort Collins, Colorado.