

## GEOTECHNOLOGIES CURRICULA IN DEPARTMENTS OF GEOGRAPHY IN THE SPANISH PUBLIC UNIVERSITIES: CHALLENGES AND PERSPECTIVES FROM THE UNIVERSITY OF BALEARIC ISLANDS

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### SUMMARY

A significant increase in demanding graduates with geographic perspectives and technological competencies is experienced in many countries with the advent of newest technological advances. However, the educational offer in geotechnologies in the Geography curricula is not consolidated and uniform in public universities of Spain. Besides, the offer of master's programs is also diverse and very concentrated in certain universities for decades. In the coming years the Spanish Academia should develop a renewal of the curricula for its adaptation to these new realities in scientific and professional frameworks. Accordingly, it is required addressing a specialized training in geotechnologies and the development of a standardized training model. From a general assessment of geotechnologies in the Spanish public university, this paper evaluates the strategy of the University of the Balearic Islands, where Geography studies are developed since the end of 1970s decade, assessing the challenges in terms of GIT training at both pre- and postgraduate levels in order to guarantee quality skills for students and their integration into working environments.

**Key words:** Geotechnology training, master programs, Spanish Geography departments

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## INTRODUCTION

The European Higher Education Area (EHEA) developed from the statements of Sorbonne (1998), Bologna (1999) and Prague (2001) provided the basis for a profound change in the European university model (Martínez Fernández & Delgado Urrecho, 2017). The process of European convergence in higher education has been a commitment to the construction of “strong universities, for a strong Europe” being one of the critical elements the incorporation of new information and communication technologies (Casado Ortiz, 2006). Consequently, Geographic Information Technologies (GIT) training may boost this innovative educational process in the field of Geography through an educational process to be determinant for stakeholders in employability. The use of GIT in public administrations as well private sector offers a new demand for new type of experts educated in this new framework (Bliš, Kovani, & Kovani, 2015).

The administrative process for the preparation of academic curricula in Spain is based on different laws (cf. BOE 2007), establishing that the bachelor’s degrees must sum up a total of 240 ECTS and their main aim is a general training adapted to the professional exercise (Esparcia Pérez & Sánchez Aguilera, 2012). The Master’s degrees are focused on specialization, encompassing a minimum of 60 ECTS. Both title types are validated by the Agency for Academic Quality and Accreditation (ANECA, its acronym in Spanish language) which releases a mandatory and determining report. Likewise, ANECA develops a continuous evaluation to maintain their accreditation.

The White Paper for the Design of the Degree in Geography and Territorial Planning (ANECA, 2004) emphasized that the geographer's specialization in Europe is focused on three main areas: territorial planning, environmental issues and geographic information technologies and its applications (ANECA, 2004, pp. 297). Normally, in current Geography curricula, GIT subjects are included in a group of subjects integrated in the Geography Techniques module; including cartography, quantitative and qualitative techniques of geographic information analysis, photointerpretation, remote sensing and geographic information systems as the common subjects. Therefore, GIT do not in themselves constitute a specific corpus in the geographer's curriculum. The offer of official Master’s degrees in GIT proposed by the departments of Geography in the Spanish public universities is scarce, but well consolidated. These are multidisciplinary programs managed by these departments of Geography but also with the participation of lecturers from other university departments or specialized professionals.

A significant offer of non-official Master's programs in GIT is deployed by Spanish public universities, normally providing a professional profile to students.

The Department of Geography at the University of the Balearic Islands (UIB) develops a training program in GIT linked to Geography degree studies, and with a non-official Master's degree in Geographic Information Technologies, although it should be noted that the integration of GIT in teaching and research issues at UIB was established at the end of the 1980's decade with the creation of the GIS Laboratory (currently the GIS and Remote-Sensing Service). Committed to its own tradition, the Department is nowadays starting the administrative and academic procedure for offering an Official Geotechnology Master program.

The objectives of this study are to (1) analyse the training offer in GIT subjects in the official Geography curricula at the Spanish public universities, (2) evaluate their effectiveness to provide for GIT professional skills, (3) assess the offer of Official master's degrees by departments of Geography of public universities evaluating their characteristics, and finally (4) deeply investigate the training offer in GIT at UIB also deliberating on the perspectives to undertake an improvement of the curricula.

## **METHODOLOGY**

A systematic analysis of the GIT training offer in Geography degrees curricula in the Spanish public universities was carried out based on web pages queries. A total of twenty-nine university web pages were visited, being their curricula and teaching guides consulted. Subsequently, those subjects referring to GIT were assessed in each university: Geographic Information Systems, Remote Sensing or Geopositioning Systems. Despite being the fundamentals in GIT, those subjects related with cartography were not analysed since many of them do not use GIT in the teaching process.

Likewise, the website of all of the departments of Geography in the Spanish public universities were visited and the official and non-official offer in master program studies in GIT verified.

Finally, the GIT training in the University of the Balearic Islands was meticulously analyzed thorough the current curricula of the Geography degree, the teaching guides of its subjects as well as the training programs of the non-official Master program in GIT.

## GEOTECHNOLOGIES IN THE DEGREES OF GEOGRAPHY IN THE SPANISH PUBLIC UNIVERSITIES

On paper, the Geography degree title qualifies for different occupations such as geographer, technician in GIS, technician in urban planning, technician in environmental management, technician in territorial planning, and teacher of Social Sciences in high school. Despite such study plan trained for these professional exercises as geographer, exclusive professional skills for geographers in Spain are still lacking. Consequently, no specific guidelines were developed in the design and elaboration of the Geography degree curricula, although the creation of the Professional Association of Geographers was approved by the Spanish Parliament 20 years ago (BOE 5/05/1999), being an important milestone for its development.

One of the main criteria used for the design and elaboration of Geography degrees curricula in Spain was the employability analysis of professional geographers conducted by the Spanish Professional Association of Geographers (Colegio de Geógrafos, 2008). This study particularly highlighted GIT skills of geographers as one of the main real market niches. The Spanish public universities offer GIT courses in twenty-nine Geography degrees in Spain. Initially, the analysis of the Geography degrees that were teaching GIT depicted different denominations of these degrees, sharing all of them the term 'Geography'. With the convergence to EHEA at the beginning of the 2010's decade, only two of them conserved the original title 'in Geography': Universitat de Barcelona and also UIB. However, during the last years three other universities recovered the title demonstrating that Geography is a consolidated science per se: Universidad de Granada, Universidad de Salamanca, and Universitat de Lleida. The other twenty-seven universities decided to add into the title several terms related with the basic skills recommended in the White Paper (ANECA, 2004). As a result, there are 15 degrees in Geography and Territorial Planning; 5 degrees in Geography; 2 degrees in Geography and Territorial Management; 1 degree in Geography and Environment; 1 degree in Geography, Environment and Territorial Planning; 1 degree in Geography, Territorial Development and Sustainability; and 1 degree in Geography, Territorial Planning and Environmental Management. Besides these titles focused on the fields of knowledge developed by the academic Geography, it is worthy to be noted that 3 degrees in Geography and History were found, the traditional combination previous to the 1990's decade.

Table 1: Geotechnology subjects offered by Geography degrees in Spanish public universities.

| University                           | Degree   | Geotechnology subjects [Course]                     | ECTS | Type |
|--------------------------------------|--|---|------|------|
| 1. Universidad Alicante              | Degree in Geography and Territorial Planning   | GIS [3]   | 6    | CS   |
|                                      |  | GIS applied to land planning [4]                    | 6    | CS   |
| 2.Universitat Autònoma de Barcelona  | Degree in Geography, Environment and Territorial Planning (Extinction)<br><br>Degree in Geography and Territorial Planning | GIS [1]   | 6    | CS   |
|                                      |  | Remote Sensing [4]                                  | 6    | OP   |
|                                      |  | Applied GIS to planning [3]                         | 6    | OP   |
| 3. Universidad Autónoma de Madrid    | Degree in Geography and Territorial Planning   | GIS [2]   | 6    | CS   |
|                                      |  | GIS applications [3]                                | 6    | CS   |
|                                      |  | Remote Sensing and Phi [4]                          | 6    | OP   |
|                                      |  | GIS [1]   | 6    | CS   |
| 4. Universitat de Barcelona          | Degree in Geography  | Physical and environmental GIS applications [3]     | 6    | CS   |
|                                      |  | Social and Economic GIS applications [3]            | 6    | CS   |
|                                      |  | Photointerpretation and remote sensing (PhI/RS) [3] | 6    | CS   |
|                                      |  | GIS and Remote Sensing [2]                          | 6    | CS   |
| 5. Universidad de Cantabria          | Degree in Geography and Territorial Planning   | Advanced GIS [3]                                    | 6    | CS   |
|                                      |  | Raster GIS [3]                                      | 6    | CS   |
| 6. Universidad de Castilla la Mancha | Degree in Geography, Territorial Development and Sustainability  | Vectorial GIS [3]                                   | 6    | CS   |
|                                      |  | Photointerpretation and remote sensing [2]          | 6    | CS   |
|                                      |  | Project GIS Workshop [4]                            | 6    | OP   |
|                                      |  | GI Technologies [1]                                 | 6    | CS   |
| 7.Universidad Complutense de Madrid  | Degree in Geography and Territorial Planning   | PhI./RS [2]   | 6    | CS   |
|                                      |  | GIS I [3]   | 6    | CS   |
| 8. Universidad de Extremadura        | Degree in Geography and Territorial Planning   | GIS II [3]  | 6    | CS   |
|                                      |  | RS / Phi [3]  | 6    | CS   |
|                                      |  | GIS and Data Bases [3]                              | 6    | CS   |
|                                      |  | GI Technologies for environmental management [4]    | 6    | OP   |
| 9. Universidad de Girona             | Degree in Geography, Territorial Planning and environmental management   | Remote Sensing for Resource Management [3]          | 6    | CS   |
|                                      |  | GIS [2]   | 12   | CS   |
|                                      |  | Advanced GIS [3]                                    | 6    | OP   |
| 10. Universidad de Granada           | Degree in Geography  | GIS [2]   | 6    | CS   |
|                                      |  | Basic on RS [3]                                     | 6    | CS   |
|                                      |  | GIS vectorial applications [4]                      | 6    | OP   |
|                                      |  | GIS raster applications and RS [4]                  | 6    | OP   |
| 11. Universitat de les Illes Balears | Degree in Geography  | GIS I [2]   | 6    | CS   |
|                                      |  | GIS II [3]  | 6    | CS   |
|                                      |  | Spatial analysis [2]                                | 6    | CS   |
| 12. Universidad de Jaén              | Degree in Geography and History  | Geography Lab. [4]                                  | 6    | OP   |

|  |  |   |                  |                      |
|--|--|---|------------------|----------------------|
| 13.<br>Universidad de la Laguna                      | Degree in Geography and Territorial Planning   | GI Technologies I [2]<br>GI Technologies II [2]<br>GI Technologies III [4]  | 6<br>6<br>6      | CS<br>CS<br>OP       |
| 14.<br>Universidad Palmas de Gran Canarias           | Degree in Geography and Territorial Planning   | GIS [2]<br>GI Technologies [2]<br>GI Data Management [3]  | 6<br>6<br>6      | CS<br>CS<br>CS       |
| 15.<br>Universidad de León                           | Degree in Geography and Territorial Planning   | GIS [3]<br>GIS II [3]<br>RS / PhI [3]   | 6<br>6<br>6      | CS<br>CS<br>CS       |
| 16. Universitat de Lleida                            | Degree in Geography  | GIS and thematic cartography [1]<br>GIS / Remote Sensing [2]<br>Advanced GI Technologies [3]<br>GIS Databases [4] | 6<br>6<br>6<br>6 | CS<br>CS<br>CS<br>OP |
| 17.<br>Universidad de Málaga                         | Degree in Geography and Territorial Management   | PhI / RS [2]<br>GIS Basics [2]<br>GIS Developments and Applications [3]<br>RS applications [4]                    | 6<br>6<br>6<br>6 | CS<br>CS<br>OP<br>OP |
| 18.<br>Universidad de Murcia                         | Degree in Geography and Territorial Planning   | PhI / RS [4]<br>GIS Basics [2]<br>GIS Applications [3]  | 6<br>6<br>6      | CS<br>CS<br>CS       |
| 19.<br>Universidad Nacional de Educación a Distancia | Degree in Geography and History  | GIS [4]   | 6                | CS                   |
| 20.<br>Universidad de Oviedo                         | Degree in Geography and Territorial Planning   | GI treatment [2]<br>GIS intro [2]<br>GIS applications [4]<br>GIS Territorial Analysis [4]                         | 6<br>6<br>6<br>6 | CS<br>CS<br>OP<br>OP |
| 21.<br>Universidad Pablo de Olavide. Sevilla         | Degree in Geography and History  | GI Technologies [3]   | 6                | CS                   |
| 22.<br>Universidad del País Vasco                    | Degree in Geography and Territorial Planning   | GIS [2]<br>GIS extension [3]<br>Ph/RS [3]   | 6<br>6<br>6      | CS<br>OP<br>OP       |
| 23. Universitat Rovira i Virgili                     | Degree in Geography and Territorial Planning<br><br>Degree in Geography, Territorial Analysis and Sustainability | Touristic Geographic Information Techniques [2]<br>GIS [2]<br>PhI/RS [3]<br>Spatial Analysis [3]                  | 6<br>6<br>6<br>6 | CS<br>CS<br>CS<br>CS |
| 24.<br>Universidad de Salamanca                      | Degree in Geography  | PhI / RS [3]<br>GIS [3]   | 6<br>12          | CS<br>CS             |
| 25.<br>Universidad de Santiago                       | Degree in Geography and Territorial Planning   | PhI /RS [2]<br>GIS Basics [2]<br>GIS and Spatial Analysis [2]<br>Advanced Cartography [2]                         | 6<br>6<br>6<br>6 | CS<br>CS<br>CS<br>CS |
| 26.<br>Universidad de Sevilla                        | Degree in Geography and Territorial Management   | GI Technologies introduction [2]<br>GIS raster [3]<br>GIS vectorial [3]   | 6<br>6<br>6<br>6 | CS<br>CS<br>CS<br>OP |

|                               |  |  |             |                |
|-------------------------------|--|--|-------------|----------------|
|                               |  | Computers and Advanced Statistics for GI Analysis [4]<br>GIS for Socioeconomic analysis [4]<br>GI Technologies, Spatial analysis and Environment [4] | 6<br>6      | OP<br>OP       |
| 27. Universidad de Valencia   | Degree in Geography and Environment          | GIS I [2]<br>GIS II [3]<br>Remote Sensing [4]  | 6<br>6<br>6 | CS<br>CS<br>OP |
| 28. Universidad de Valladolid | Degree in Geography and Territorial Planning | GIS I [3]<br>GIS II [3]<br>Remote sensing [2]  | 6<br>6<br>6 | CS<br>CS<br>CS |
| 29. Universidad de Zaragoza   | Degree in Geography and Territorial Planning | Remote Sensing [3]<br>GIS [2]  | 6<br>9      | CS<br>CS       |

(CS: Compulsory, OP: Optative, GI: Geographic Information, GIS: Geographic Information Systems, PHI: Photo-Interpretation)

The Table 1 showed a total of 86 subjects in GIT (525 ECTS) were computed in the different web queries, being 66 compulsory (405 ECTS) and 20 optative (120 ECTS). The offer of GIT subjects per degree course for all the universities was as follows: 4 subjects offered in the first course, 26 in the second one, 32 in the third and 24 in the fourth. The average credits in GIT by degrees in Geography (excluding Geography and History) was 19.5 ECTS. Three universities only offered 6 ECTS, being those with educational plans focused on Geography and History. The rest were computed with three universities 12 credits, one university 15, fourteen universities 18, seven universities 24 and one university 36 (Universidad de Sevilla).

The training model in GIT subjects is also diverse. Some universities divided the subjects according to the used geographic data model (SIG raster/SIG vector), others organized the GIS subject in an introductory GIS I subject and an advanced GIS II, others directly referred to GIT, etc. Remote sensing subject was independently offered in very few plans, being usually included with photointerpretation. Geographic database management also appeared as a subject in some cases.

## OFFICIAL MASTER PROGRAMS OFFERED BY THE DEPARTMENTS OF GEOGRAPHY IN SPANISH PUBLIC UNIVERSITIES

Five departments of Geography in public universities offered Masters in GIT. These were six courses of 60 ECTS with a high specialization level. Five of them were classroom courses and one as semi-virtual. They were Official Master Programs with a great prestige achieved through the large number of developed editions (Table 2). These official postgraduate degrees allowed the student to start doctoral studies. The enrolment requirements do not impose restrictions on graduates from different disciplines; such as Environmental

sciences, Engineering, etc., even allowing an academic demand from the departments related with these disciplines.

Table 2: Master Program offered by the departments of Geography in Spanish public universities

| University   | Master Program   | Subjects  |
|--|--|---|
| Universidad de Alcalá de Henares<br><br><a href="http://geogra.uah.es/master/">http://geogra.uah.es/master/</a>      | University Master Program in Geographic Information Technologies<br><br>Total: 60 ECTS<br><br>9 <sup>th</sup> Edition<br><br>Specialization lines:<br><b>Research</b><br>CS 30 ECTS<br>OP 16 ECTS<br>Master Thesis: 10 ECTS<br>Research Methods: 4 ECTS<br><br><b>Professional</b><br>CS: 30 ECTS<br>OP: 8 ECTS<br>Master Thesis: 10 ECTS<br>Practicum: 9 ECTS<br>Business: 3 ECTS | <ul style="list-style-type: none"> <li>- Thematic cartography (CS) 6 ECTS</li> <li>- Geography and cartographic communication (OP) 4 ECTS</li> <li>- Remote Sensing (CS) 6 ECTS</li> <li>- Classification techniques in remote sensing (OP) 4 ECTS</li> <li>- Data acquisition techniques in remote sensing (OP) 4 ECTS</li> <li>- Monitoring and modelling of dynamic processes (OP) 4 ECTS</li> <li>- Input, modelling and data transformation (CS) 6 ECTS</li> <li>- Fundamentals of analysis and spatial reasoning (CS) 6 ECTS</li> <li>- Procedures and methods of territorial analysis with GIS (OP) 4 ECTS</li> <li>- Programming in GIT (CS) 6 ECTS</li> <li>- Advanced Programming (OP) 4 ECTS</li> <li>- Research methods) OB) 4 ECTS</li> <li>- Master Thesis (CS) 10 ECTS</li> <li>-Business organization (CS) 3 ECTS</li> <li>-External practices (CS) 9 ECTS</li> </ul> |
| Universitat Autònoma de Barcelona<br><br><a href="http://www.crea.uab.es/master/">http://www.crea.uab.es/master/</a> | University Master Program in Remote Sensing and GIS<br><br>Total: 60 ECTS<br><br>21 <sup>st</sup> Edition<br><br>Specialization lines:<br><br><b>GIS</b><br><b>Remote Sensing</b>  | <ul style="list-style-type: none"> <li>-Science of Geographic Information, Remote Sensing and GIS (CS) 15 ECTS</li> <li>-Processing of Remote Sensing Images (CS) 6 ECTS</li> <li>- Spatial Analysis (CS) 9 ECTS</li> <li>-Graphic information collection methods (CS) 6 ECTS</li> <li>-Formation advanced in GIS (OP) 9 ECTS</li> <li>-Formation advanced in remote sensing (OP) 9 ECTS</li> <li>-Master Thesis (CS) 15 ECTS</li> </ul>  |
| <a href="http://geograf.ia.uab.cat/geoinformacio/">http://geograf.ia.uab.cat/geoinformacio/</a>                      | University Master Program in GeoInformation<br><br>Total: 60 ECTS<br><br>21 <sup>st</sup> edition<br><br>Specialization lines:   | <ul style="list-style-type: none"> <li>-Geospatial data (CS) 12 ECTS</li> <li>-Geospatial systems (CS) 12 ECTS</li> <li>-Programming techniques and geoinformation (OP) resources 12 ECTS</li> <li>-Program Development (OP) 12 ECTS</li> <li>-Information Management (OP) 12 ECTS</li> <li>-Geoapplications for Smart cities (OP) 12 ECTS</li> <li>-Professional Practices (CS) 6 ECTS</li> <li>-Master final work (CS) 6 ECTS</li> </ul>  |



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|--|--|---|
|  | <p><b>GIS applications</b><br/>development:<br/>CS 24 ECTS<br/>OP1: 24 ECTS</p> <p><b>Information Management for smart cities</b><br/>CS 24 ECTS<br/>OP2: 24 ECTS</p> <p>Practicum: 6 ECTS<br/>Master Thesis: 6 ECTS</p> |   |
| <p>Universidad Complutense de Madrid</p> <p><a href="https://www.ucm.es/master-geografia">https://www.ucm.es/master-geografia</a></p>  | <p>Universitary Master Program in GI Technologies<br/>Total: 60 ECTS</p> <p>10<sup>th</sup> edition</p>  | <p>Cartography I (CS) 6 ECTS<br/>SIG (CS) 6 ECTS<br/>Remote Sensing (CS) 6 ECTS<br/>Cartography II (OP) 6 ECTS<br/>Spatial Statistics (OP) 6 ECTS<br/>SIG II (OP) 6 ECTS<br/>Databases (OP) 6 ECTS<br/>Programming (OP) 6 ECTS<br/>Applications GIT Environment (OP) 6 ECTS<br/>Applications GIT Urban Studies (OP) 6 ECTS<br/>External practices (CS) 6 ECTS<br/>Master thesis (CS) 6 ECTS</p>   |
| <p>Universidad de Extremadura</p> <p><a href="https://www.unex.es/conoce-la-unex/centros/fyl/titulaciones/info/presentacion?id=0437">https://www.unex.es/conoce-la-unex/centros/fyl/titulaciones/info/presentacion?id=0437</a></p> | <p>University Master program in GI Technologies and Remote sensing</p> <p>Total: 60 ECTS</p> <p>12<sup>th</sup> edition</p> <p>Semi-virtual Classroom: 15%<br/>Virtual: 45%</p>  | <p>Advanced spatial analysis (CS) 6 ECTS<br/>Advanced learning in SIG Raster (CS) 6 ECTS<br/>Advanced learning in GIS Vector (CS) 6 ECTS<br/>Spatial Databases (CS) 6 ECTS<br/>GIS &amp; Remote Sensing (CS) 6 ECTS<br/>Design GIS projects (CS) 6 ECTS<br/>Master thesis (CS) 12 ECTS<br/>Geostatistics and Information Quality (OP) 6 ECTS<br/>Geoportals (OP) 6 ECTS<br/>Internships in business (OP) 6 ECTS<br/>SIG Programming (OP) 6 ECTS</p>   |
| <p>Universidad de Zaragoza</p> <p><a href="https://estudios.unizar.es/estudio/ver?id=608">https://estudios.unizar.es/estudio/ver?id=608</a></p>  | <p>Master's Degree in Geographic Information Technologies for Land Management: GIS and Remote Sensing</p> <p>Total: 60 ECTS</p> <p>17<sup>th</sup> edition</p> <p>Specialization: GIS / Remote Sensing</p>               | <p>Collection and organization of geographic information (CS) 10 ECTS</p> <p>Analysis of geographic information GIS (CS) 12 ECTS</p> <p>Analysis of geographic information: Remote Sensing (CS) 3.5 ECTS</p> <p>Visualization, presentation and dissemination of geographic information (CS) 6 ECTS</p> <p>GIT applications to land management: socio-economic environment (OP) 2 ECTS</p> <p>Applications of GIT to land management: environment. (OP) 2 ECTS</p> <p>Principles of Cartographic Design (OP) 2 ECTS</p> |

|  |  |   |
|--|--|---|
|  |  | Basic notions about GIS (OP) 2 ECTS<br>Fundamentals of Remote Sensing (OP) 2 ECTS<br>Master thesis (CS) 12 ECTS |
|--|--|---|

## NON-OFFICIAL MASTER PROGRAMS

The non-official Masters training offer promoted by departments of Geography was not supported by the same information channels exhibited by the Official Master’s programs. The exploration in different web pages of Spanish public universities showed how these master degrees were independently managed by each university, without the control of external agencies. As a result, university foundations are normally the responsible to manage these type of courses. A specific master degree diploma is generally released by each university, although not enabling to follow doctoral studies neither obtaining European accreditation.

In the Table 3 are explained two examples of non-official Master’s programs taught by the Universitat de Girona and Universidad de Sevilla were selected because both illustrated a specific and representative pedagogical structure focused on semi-virtual and classroom master types with a consolidated prestige in the last two decades.

Table 3: Non official Master Program offered by Geography departments of Public Universities

| University   | Master Program   | SUBJECTS   |
|--|--|--|
| Universitat de Girona<br><a href="https://www.unigis.es/master-sig-online/">https://www.unigis.es/master-sig-online/</a> | University Master Program in Geographic Information Technologies<br><br>Total: 60 ECTS<br><br>22 <sup>nd</sup> edition<br><br>Specialization:<br><br>A. Geocomputation and programming<br><br>B. Geospatial Analysis | Course I<br>Basics on GIS (6 ECTS)<br>Spatial data models (6 ECTS)<br>Spatial data sources (6 ECTS)<br>Data visualisation and cartography (6 ECTS)<br>GIS Project management (6 ECTS)<br><br>Course II<br>Spatial Databases (6 ECTS)<br>Final Master Thesis (6 ECTS)<br><br>Specialization A:<br>Distributed GIS and interoperability (6 ECTS)<br>Web Map applications (6 ECTS)<br>Python GIS programming (6 ECTS)<br><br>Specialization B:<br>Geographic Analysis (6 ECTS)<br>GIS and Remote Sensing (6 ECTS) |

|  |  |  |
|--|--|--|
|  |  | GIS and Territorial Planning and Management (6 ECTS)   |
| <p>Universidad de Sevilla</p> <p><a href="https://cfp.us.es//cursos/mu/sistemas-de-informacion-geografica-planificacion-ordenacion-territorial-y-medio-ambiente/5820/">https://cfp.us.es//cursos/mu/sistemas-de-informacion-geografica-planificacion-ordenacion-territorial-y-medio-ambiente/5820/</a></p> | <p>Geographic Information Systems: Planning, Territorial Planning and Environment</p> <p>Total: 60 ECTS</p> <p>16<sup>th</sup> Edition</p> | <p>GIS Basics and Spatial Data Sources (Data &amp; Services) 2 ECTS</p> <p>General Introduction ArcGIS: data management and edition (3 ECTS)</p> <p>Spatial components of geographic data: spatial reference systems and GPS (3 ECTS)</p> <p>DBMS and Spatial Databases (12 ECTS)</p> <p>Spatial Analysis: Vector model (4 ECTS)</p> <p>Spatial Analysis: Raster model (4 ECTS)</p> <p>Web-GIS Technologies intro (5 ECTS)</p> <p>Web Map Server – Web Mapping (4 ECTS)</p> <p>Programming Web-GIS environments and Geo-viewers (5 ECTS)</p> <p>Practicum (8 ECTS)</p> <p>Master Thesis (6 ECTS)</p> |

## **GEOTECHNOLOGIES STUDIES AT THE UNIVERSITY OF THE BALEARIC ISLANDS**

### **GT AT GEOGRAPHY DEGREE**

The University of the Balearics Islands offer the degree of Geography following the official rules in Spain (BOE, 2007), adapted to the EHEA.

The Geography degree curricula of the University of the Balearic Islands was started to be taught in the course 2009-2010 (BOE, 2010) and was committed to providing an academic, generalist, and rigorous training, ensuring a solid formation in the main fields of knowledge such as Physical Geography, Human Geography, and Regional Geography Assessment, but at the same time with a strong presence of technical subjects as transversal skills. This statement guarantees to the future graduates sufficient technical and professional training to ensure their employability (Geography Degree Report, UIB, pp. 11)

The curricula established a total of 240 ECTS structured into the following types of subjects by Law: Basic Training-60 ECTS, Compulsory-132 ECTS, Optional 30 ECTS, External Practices-12 ECTS, Final Degree Project-6 ECTS. Based on the regulations for the design and elaboration of official degrees in Spain, the deployment of subjects is 6 ECTS, involving a total of 5 subjects per semester.

In turn, the subjects were also structured into the following modules:

- Core. It embraces the group of subjects for acquiring the basic Geography skills constituting the central axis of the degree (84 ECTS/35%).
- Support. It is a module including those subjects to achieve complementary skills (30 ECTS/12.5%).
- Instrumental. The subjects that compound this module (54 ECTS /22.5%), allow the acquisition of specific technical skills and abilities required for the professional practice.
- Professional Orientation. It deploys those skills for deepening the professional profile of the future graduates (48 ECTS/20%).
- Transfer. Subjects developing those skills for an effective application of those knowledges, abilities and skills learnt in previous modules. (24 ECTS/10%).

The subjects referred to GIT are included into the Instrumental Module with a total of 54 ECTS corresponding to 9 compulsory subjects adding 12 credits of optative subjects. They are grouped into three materials: Cartography (24 ECTS), Statistics (12 ECTS) and Applied Technologies (30 ECTS).

Regarding the GIT, the UIB degree title sets two objectives:

- To form in the application of theoretical, methodological and instrumental knowledge to the integrated analysis and interpretation of spatial processes and problems, as well as the development of territorial diagnoses.
- To provide specific skills related to the knowledge of field and laboratory work techniques, especially those related to the collection, analysis, treatment and representation of spatial, geographical and cartographic information and their technological instruments

Regarding the specific training in GIT provided by the UIB curricula, the following professional profiles are indicated:

- Definition, development, implementation and management of GIS.
- Development and management definition of territorial and thematic mapping.
- Development and management of information, territorial indicators through the use of databases.
- Global Positioning System (GPS).
- Remote sensing and photogrammetry.

The teaching guides contents of the GIT subjects for the 2019-2020 academic year are presented in table 4, showing their specific skills as an introduction to this matter with a pre-graduate level.

Table 4: GIT subject syllabus course 2019-2020

|  |  |   |
|--|--|---|
| Spatial Analysis<br>6 ECTS<br>2 <sup>nd</sup> year | Introduction<br>Qualitative spatial analysis techniques<br>Exploratory Spatial Data Analysis   | Spatial Patterns<br>Multivariate analysis   |
| GIS I<br>6 ECTS<br>2 <sup>nd</sup> Year            | GIS components, functions, evolution<br>GI components, types, scales<br>Spatial data models<br>Spatial Data Bases: design, creation, exploitation<br>Analysis functions: vectorial<br>Analysis functions: raster | Digital elevation models<br>Spatial data infrastructures<br>Cartographic production<br>GIS software<br>GIS applications |
| GIS II<br>6 ECTS<br>3 <sup>rd</sup> Year           | Introduction remote sensing<br>Image classification and analysis<br>LiDAR: data analysis and applications<br>Network analysis<br>Advanced geostatistics  | Multicriteria Analysis<br>3D modelling<br>Spatial data quality<br>On line Mapping                                       |

### NON-OFFICIAL GEOTECHNOLOGY MASTER PROGRAM

The "Master in Geographic Information Technologies" was an innovative, complete and rigorous training project in terms of its theoretical and practical contents; a pioneering initiative at the national level in virtual education systems in GIT. The project was designed jointly by the Geographic Information Systems Service and the former Department of Earth Sciences (in September 2015 the Department recovered the title of Department of Geography, changed in 1985) of the University of the Balearic Islands. The course was approved on May 2012 by the Governing Council of the University of the Balearic Islands. The course covered a total of 60 ECTS distributed in 10 modules subsequently structured in four main axes (see Table 5).

Table 5: Educational structure of the GIT Non-Official Master of the University of the Balearic Islands.

| MODULE   | SUBJECTS  |
|--|---|
| Basics on GI Technologies (15 ECTS)                    | Digital Cartography & GIS (6 ECTS)<br>Remote Sensing (6 ECTS)<br>Spatial Data Infrastructures (3 ECTS)  |
| GIS and spatial analysis (18 ECTS)                     | Vectorial spatial analysis (6 ECTS)<br>Raster spatial analysis & Digital Elevation Models (6 ECTS)<br>Network Analysis (3 ECTS)<br>Geostatistics (3 ECTS) |
| Spatial Databases and geospatial programming (18 ECTS) | Spatial Data Bases management (9 ECTS)<br>GIS programming (9 ECTS)  |
| GIS applications and GIS projects (9 ECTS)             | GIS applications (6 ECTS)<br>GIS projects (3 ECTS)  |
| Master Thesis include a project of each module         | Computed as virtual (10 ECTS)   |

The main objective of the course is to provide specialized training for graduates in the use of geographic information technologies from two perspectives. Firstly, as a methodological tool to support the diverse knowledge background of the students (Geography, Biology, Agricultural Engineering, Architecture, etc.). Secondly, because it constitutes a complete and specialized training with a clear projection by integrating technological and professional skills. For this reason, the course contents emphasize and deploy the learning of technological aspects of databases and application programming. The main aim is to achieve a specialized knowledge in geographic information technologies, but also the capacity to implement GIS technology.

The training of each module allows to starting without previous knowledge of the students into the skills, especially on the teaching-learning process of the most technological modules where databases and programming are explained. With this training project, UIB was committed to promoting high-quality education, with a strong impact on the labour market and entailing a low cost for the students. The course was adapted to the EHEA and to the requirements established by the internal academic regulations of the UIB.

The teaching staff of the course includes permanent lecturers from the Department of Geography, the Department of Mathematics and Computing, and the Department of Physics, as well as technical staff from the Geographic Information Systems Service and external specialized professionals who develop their activity in public administrations and companies in the Balearic Islands related to the geographic information technologies such as: Balearic Islands Government, Consell Insular de Mallorca, the public company SITIBSA SA, and the Cadastral Management Center.

## **DISCUSSION AND CONCLUSIONS**

GIT are a matter of great importance in the formation of geographers; however, a detailed analysis of the training offer of the Geography degree curricula does not show coherence or uniformity regarding the training load deployed in the different Spanish public universities. The distribution of the subjects and credits showed substantial differences between universities. It can be stated that the incorporation into the curricula of new subjects in GIT may increase the lack of uniformity between curriculums. Heterogeneity here depicted on GIT training offer could disagree with some other published studies that argued a common basis in the Geography degree curricula in Spain (cf. Orueta, 2004).

A debate arose within the Spanish Geography Academy few decades ago on the effect caused by the emergence of GIT in the academic and scientific fields of Geography (Wright et al., 1997; Tapiador & Marti, 2007). The final consequence of this debate produced a decrease on the potential dynamics that GIT could have developed in most of the Spanish public universities. From the generalized motivation, the Spanish University moved towards a model that lethargic the exponential growth initially emerged in the 1990's decade. Chuvieco et al. (2005, pp. 53) literally pointed out that "it seems necessary to change the current consideration of GIS in Geography, estimating them as central disciplines of research and geographical teaching". It is not enough, in our opinion, to timidly introduce subjects related to these techniques into the curricula, if there is no greater involvement of the most consolidated geographers in the study and research of these disciplines, which allows students to offer innovative teaching, fuelled by the resolution of specific geographical problems".

The last decade demonstrated that those universities opting for GIT consolidated their studies, especially postgraduate studies. The direct consequences have been a clear improvement in their dynamics at the academic and scientific frameworks of Geography. Despite these concerns, a unanimous agreement existed on emphasizing the role of GIT as essential tools in the formation of the current geographer (ANECA, 2004, pp. 104). Besides, they also played an essential and profound role in geographical research (Moreno Jiménez, 2013). Although the convergence process to the EHEA could have boosted the criteria unification of GIT in Geography curricula, this process was not achieved in the Spanish public universities. Consequently, there is no common curricular program in GIT with a wide variety of academic approaches and teaching loads in Spain. This curricula structure does not allow standard contents in GIT subjects. For years, work has been carried out on proposals to adapt geotechnology/geographic information science training (Bosque-Sendra, 1999), but without enough progress. This type of standardization problem in GIT training is common to other countries (Plessis & Niekerk, 2013), underlining the need for standardization through the development of specific academic programs (Vandenbroucke, et al., 2016; DiBiase, et al. 2006).

In the coming years, a reform of the university degrees in Spain must be undertaken (BOE, 2015). In this way, universities may voluntarily reduce their degree studies from four to three years. Independently from the final decision adopted by each university, this context may lead to a fundamental change for Geography pre- and postgraduate studies in which GIT could play a leading role in this major renovation process (Gutiérrez-Herández, 2016).

Since the second half of the 20<sup>th</sup> century, as a scientific discipline, Geography has been repeatedly experiencing deep identity crises affecting its essence.

These crises prominently contribute to increasing its lack of accuracy in objectives and methods (Sallent, 2018, pp. 53), leading to a constant review of its formative aspects. GIT are responsible for the major changes in the geographic discipline in recent decades, although there is not a general consensus on the scope and meaning of these changes (Moreno Jiménez, 2013, pp. 6). However, the generation of geographical knowledge through GIT involves a new understanding and research practice (Viles, 2016). In addition, GIT can promote a repositioning of geographic knowledge contributing to their useful applications.

In postgraduate studies, a formalisation dynamic of master's studies in GIT has been developed in the last decade with the EHEA convergence because fundamental differences between both the official and non-official curricula: 1) the diploma obtained in the official master's is applicable to the entire EHEA, while the non-official masters cannot be recognized, (2) the teaching of official master's degrees must necessarily be carried out by the university teaching staff, while in the non-official titles a greater number of professionals of the private company and/or administration can participate, (3) the economic cost of Master's degree programs are usually higher than official master's degrees, whose cost is regulated by the Spanish Government. This fact promotes a competition between the official and non-official Masters Programs that are progressively causing the extinction of non-official ones.

In the case of the University of the Balearic Islands, similarly to other Spanish universities, the imminent reform of the curricula poses a series of relevant challenges regarding GIT. The first one is identifying the best training in GIT to be proposed in Geography degree curricula: subjects, teaching loads, contents, and methodologies. The second challenge is to deliberate on the feasibility of official master studies in GIT considering the EHEA provides a nationally and internationally framework with large offer to the students. In this way, the low and undefined demand of students recommends that virtual or semi-virtual courses could be a clear option to be explored. Thirdly, a rethinking will be necessary about the non-official GIT post-graduate titles to be launched.

## REFERENCES

1. ANECA. (2004). Libro Blanco para el diseño del Título de Grado en Geografía y Ordenación del Territorio. Madrid: Aneca
2. Bliš, P., Kovani, L., & Kovani, M. (2015). The Importance Of Geographic Information Systems Education At Universities In The Process Of Building A European Knowledge- Based Society. *Procedia - Social and Behavioral Sciences*, 191, 2458–2462.



- <https://doi.org/10.1016/j.sbspro.2015.04.358>
3. Boletín Oficial del Estado –BOE (2010). *Resolución 11583 de 28 de junio de 2010, de la Universidad de las Illes Balears, por la que se publica el plan de estudios de Graduado en Geografía*: BOE 19 de julio de 2010, nº 174, pág. 63808. Available at: <http://www.boe.es/boe/dias/2010/07/19/pdfs/BOE-A-2010-11583.pdf>.
  4. Boletín Oficial del Estado –BOE (2007) *Ley Orgánica 4/2007, de 12 de abril, por la que se modifica la Ley Orgánica 6/2001, de 21 de diciembre, de Universidades* BOE, de 13 de abril de 2007, nº 89, pág. 16241 a 16260. Available at: <https://www.boe.es/eli/es/lo/2007/04/12/4>
  5. Boletín Oficial del Estado –BOE (2007) *Real Decreto 1393/2007, de 29 de octubre, por el que se establece la ordenación de las enseñanzas universitarias oficiales*. BOE, núm. 260, de 31 de octubre de 2007, nº 260, pág. 18770. Available at: <https://www.boe.es/eli/es/rd/2007/10/29/1393/con>
  6. Boletín Oficial del Estado –BOE (2015) *Real Decreto 43/2015, de 2 de febrero, por el que se modifica el Real Decreto 1393/2007, de 29 de octubre, por el que se establece la ordenación de las enseñanzas universitarias oficiales, y el Real Decreto 99/2011, de 28 de enero, por el que se regulan las enseñanzas oficiales de doctorado*. BOE, nº 29, de 3 de febrero de 2015, pág 8088 a 8091. Available at: <https://www.boe.es/eli/es/rd/2015/02/02/43>
  7. Bosque-Sendra, J. (1999). Nuevas perspectivas en la enseñanza de las tecnologías de la información geográfica. *Serie Geográfica*, 8, 25–34.
  8. Casado Ortiz, R. (2006). Convergencia con Europa y cambio en la universidad. *Educec*, 20.
  9. Chuvieco, E., Bosque, J., Pons, X., Conesa, C., & Santos, J. M. (2005). ¿Son las tecnologías de la información geográfica (TIG) parte del núcleo de la geografía ? *Boletín de La AGE*, 40, 35–56.
  10. Colegio Profesional de Geógrafos (2008): Perfiles profesionales de los geógrafos en España.
  11. DiBiase, D., DeMers, M., Johnson, A., Kemp, K., Luck, A. T., Plewe, B., Wentz, E., Eds. (2006). *Geographic Information Science & Technology Body of Knowledge*. Washington, D.C., Association of American Geographers.
  12. Esparcia Pérez, J., & Sanchez Aguilera, D. (2012). De la teoría a la práctica. el proceso de diseño e implantación de los grados de geografía en las universidades españolas. *Boletín de La Asociación de Geógrafos Españoles*, 58, 405–428.
  13. Gutiérrez-Herández, O. (2016). *La geografía y los geógrafos ante la*

*reforma universitaria ¿Una oportunidad para definir los contenidos esenciales del Grado en Geografía?* (Vol. 5).

14. Martínez Fernández, L. C., & Delgado Urrecho, J. . (2017). La Geografía en las enseñanzas universitarias de Grado en España : docencia y planes de estudios Geography in university academic degrees in Spain : teaching and curricula, 61–79. <https://doi.org/10.14198/INGEO2017.67.04>
15. Moreno Jiménez, A. (2013). ENTENDIMIENTO Y NATURALEZA DE LA CIENTIFICIDAD GEOTECNOLÓGICA : UNA APROXIMACIÓN DESDE EL. *Investigaciones Geográficas*, 60, 5–36. <https://doi.org/10.14198/INGEO2013.60.01>
16. Orueta, E. L. B. De. (2004). La base formativa común en la enseñanza universitaria de la geografía en españa. *Boletín de La AGE*, 38, 47–70.
17. Plessis, H., & Niekerk, A. Van. (2013). A Comparison of Geographical Information Science Competency Requirements. *South African Journal of Geomatics*, 2(3), 206–217.
18. Sallent, A. (2018). Higher education and teaching of Geography in Spain today. *Redu*, 16(1), 2–3.
19. Tapiador, F. J., & Marti, J. (2007). Best of Times , Worst of Times : A Tale of Two ( Spanish ) Geographies. *Journal of Geography in Higher Education*, 31(1), 81–96. <https://doi.org/10.1080/03098260601033043>
20. Vandenbroucke, D., & Vancauwenberghe, G. (2016). Towards a new Body of Knowledge for Geographic Information Science and Technology.. *Micro, Macro & Mezzo Geoinformation*, 2016(6), 7-19.
21. Viles H. 2016. Technology and geomorphology: Are improvements in data collection techniques transforming geomorphic science? *Geomorphology* 270 : 121–133. DOI: 10.1016/j.geomorph.2016.07.011
22. Wright, D.J.; Goodchild, M.F. i Proctor, J.D. (1997). «GIS: tool or science? Desmystifying the persistent ambiguity of GIS as “tool” versus “science”». *Annals of the Association of American Geographers*, 87, 346-362.
23. UIB (2012) . Memoria título propio de Màster en Geotecnologías. Acord del Consell de Govern de la Universitat de les Illes Balears del dia 14 de maig de 2012.