Map Viewers in Spain – Tools for Learning Geography in Schools

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Abstract

In recent years, geographic information systems available on the Internet have been improved, the number and what they offer has increased. The quality of geographical and cartographical information has also been improved. In Spain, the National Geographic Institute has developed a Spanish Spatial Data Infrastructure and other complementary tools which allow displays of digital maps by means of so called map viewers on line. The process has become extremely simple and this promotes its potential educational value. This opens up an enormous number of possibilities to make and use didactical resources in teaching and learning of geographical content included in the national curriculum subjects in Spanish Secondary Education. Similarly, map viewers foster the acquisition of spatial social and technological competences specific to geographic education.

1 Spatial Data Infrastructures in Spain

The widespread use of new communication and information technologies is an unquestionable fact which is apparent every day in increasing the spread of digital devices, as well as in increasing the supply of computer applications, among which those related to geographic information are included. This digital revolution is linked to the use of geographic information. It has been characterized by three main features: the growing variety of programmes and geographic information systems, the improvement of data collection, its computer treatment and the improving cartographic results and, finally, its spread and availability via the Internet. The purpose of this paper is to recap the situation concerning Spanish geographic information systems now available on the Internet and explain their potential, from an educational point of view, as didactic tools in the teaching and learning of geographical content in secondary education. Deliberately, the didactical use of the popular programme Google Earth and its complementary Google Maps is not covered here but is reviewed in other papers (DE MIGUEL 2006, GÓMEZ 2010, LUQUE 2011).

Online geographical information systems configured as cartographic viewers have as their main educational virtue the fact that they are actually maps generated from geographical and statistical variables. Firstly, the MapTem programme, is very useful for the automatic making of maps related to the geography of Spain and in the elaboration of cartography from databases tables, such as demographic, social and economic data of Spanish municipalities. The PXMap programme allows users to generate their own statistical maps from tables containing territorial information. These data tables must be linked to another programme that is PC-Axis. The maps allow the representation of values of thematic variables with geographical information at a regional, provincial and municipal level. The acquisition of this programme and the databases for making maps is included in the web

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page of the National Institute of Statistics (www.ine.es). Besides the reliability of the data, maps made from this tool are very easy to make. Thus, INE suggests different types of data which can be mapped: such as from the town register, population and housing census (overall population, population by age, sex, nationality and country of birth, buildings, houses, homes) and agricultural census. Other statistical databases exist such as those included in the official statistical agency of economic, social and environmental character, these can be treated cartographically and, subsequently, transferred to the classroom. By contrast, this is a "closed" cartography, that is to say, once performed it does not allow modifications or changes of scale or orientation, since they are maps consisting of a single layer of information.

The previously mentioned programmes are a good complement to the main instrument for map making online from geographic information systems: the Infrastructure of Spanish Spatial Data (IDEE, henceforth). Through the supervision of the Geographic High Council, IDEE has as its main objective the integration of data from the Internet, *metadata*, services and geographical information happening in Spain. It offers the location, identification, selection and access to such resources to users from the IDEE website (http://www.idee.es). The site integrates the nodes and IDE resource websites of producers of geographic information at a national, regional and local level, with all kinds of data and geographic information services available in Spain. Among the interesting educational tools within the IDEE is a basic viewfinder WMS (Web Map Service) of geographical information, which, having selected the spatial data, allows the making of thematic cartography, which is easily transformed in the image formats used habitually (JPEG, GIF o PNG) for digital classroom use. But the great advantage of this tool is that it is an online GIS, that is to say, it contains several layers of geographical information, and, besides, it allows maps to be made in real time online. Therefore it offers the possibility to perform dynamic analyses of territory. In this way, the student discovers the complexity of physical and human factors, which may be involved in the landscape configuration and spatial processes.

The IDEE display allows users to load data layers from a wide variety of sources. These include those referred to by administrative divisions, postal addresses of the Cartocity database, land lot cadastre, the agricultural geographic information system (SIGPAC), maps of crops and exploitation, the system of protected natural areas, forest and geological maps of Spain, the system of town planning information (SIU), as well as the main databases of the National Geographic Institute (IGN), the IGN base map, images of the National Plan of Aerial Ortophoto (PNOA) and maps of slopes. All this cartography refers to databases which cover the entire national territory, although the great advantage of these tools is that the scale of map visualization can be personalized. Other remarkable projects of IDEE are the Climatic Digital Atlas of the Spanish Peninsula and the Infrastructure of Spatial Data from the Sustainability Observatory in Spain (IDEOSE) which allows to view the cartography of the land use from the project Corine Land Cover (CLC).

Project IDEE has been connected to the various services and cartographic institutes of the autonomous communities, so that complementary data to the former proposed by the regional administrations can be obtained and mapped either in the general viewer of IDEE. or via viewers in the respective autonomous web pages. In any case, there are several contributions of information, which, although they are confined to the regional level in terms of origin, have also a scientific geographic foundation, and, therefore, didactic potential. For example, the map viewer in Andalusia allows users to view the contour lines

of the topographical map, Aragón offers environmental data and location of the facilities, Canarias and Castile La Mancha have digital models of the land, Catalonia the topographical map in different scales or the location of facilities and services, in Navarre noise maps, in Valencia maps of environmental risk, in the Balearic islands economic data such as tourist establishments or regional and insular planning ordinances, in the Basque data about hydro geography, etc. Similarly, there are town councils which have also developed infrastructures of spatial data at a local level tenabling them to offer map visualosations about facilities, public services, transport, etc., or town planning viewers which allow to make didactical resources for the study of the social and cultural environment closer to the students.

The National Geographic Institute itself along with the National Centre of Geographic Information (CNIG) have developed tools complementary to IDEE, which are based in geographical information systems, they are also available on the Internet and which allows citizens to consult and make cartography additional to that offered by IDEE. Iberpix is an application for viewing raster maps, satellite images and orthophotos such as documents with full cartographical validity. Unlike the satellite image viewers such as Google Earth, this application allows users to enter geographical data provided by IGN, as well as the ones from the National Topographical Map and those from PNOA. The possibility of saving the maps generated in jpg format as a geographical image opens up opportunities to use this as a didactic resource in the teaching and learning of Geography. Another viewer is the system of Geographical Information of Spain (SIGNA) which contains less information than IDEE, but it is easier to use when dealing with layers of geographical information.

As a last example of an Information system is the one referred to the National Atlas of Spain (SIANE) which allows on-line access by means of personalized queries to the updated geographical information and to individual digital content: the outputs can be in the form of a map, an image, an epigraph, etc. On the other hand the digital facsimile edition of the thematic groups from the National Atlas of Spain (1986-2008) has become an important bank of cartographical resources but limited in digital format. As a result, its didactical usefulness is low. In any case, the combined use of the Atlas with its complementary SIANE does nothing but increase the availability of resources for studying Geography.

2 Digital Maps: Acquiring Geographical Skills and Curricular Innovation

We are, then, faced with a large number of cartographical resources for teaching and learning Geography, which have superseded the usual maps found in textbooks, the outline maps, wall maps or globes so characteristic of conventional classrooms for the teaching of Geography. The variety of resources which can be counted upon nowadays, thanks to new information technologies have fostered not only different teaching practices, innovation and the improvement in the didactical approaches to teaching Geography in the classroom, but also is encouraging the first steps of a multimedia pedagogical revolution.

Maps are not the only resource used in teaching Geography, but with modern developments and wider availability, they are acquiring more importance due to the pervasive provision of digital tools in the classrooms (computers and projectors). This is making Geography more visual and therefore more motivating for students. Geography is the science of

territory and cartography is the optimal way of representing and interpreting this. The improvement of cartographical technologies has been greater than any other in the study and research of geographical space and ignoring this advance in the teaching at secondary schools would be a mistake. Digital cartography does not only incorporate new representations, for instance, satellite images and orthophotos which were hardly used until recently in secondary schools, it also serves two of the biggest challenges in the teaching of Geography, teaching to think about spaces and teaching to think spatially, for which it is necessary to know the thematic diversity of the elements which make up the landscape (physical, social, economic, institutional, etc.) and understand the analysis of different spatial aspects at different scales.

On the other hand, the design of cartographical viewer interfaces, their ease of use, the immediate representation of the demanded map and the accessibility of students to the Internet either in schools or their own homes fosters its educational use. Recent research points out the virtues of using geographic information systems in schools (BOIX & OLIVELLA 2007, LUQUE 2011). These authors consider GIS use as important educational activities because they foster methodological and curricular reform, improve student intellectual abilities, increase the skills needed to access and treat information, improve creativity and the develop skills in using computer technology. It also favours the autonomous and active work of individuals who become conscious of their own learning, and, at the same time, allows collaborative work.

3 Future Perspectives

It is not possible to know how the teaching of school geography will be like in the future. However, the progressive use of new technologies such as digital cartography seems to become of greater importance. Nevertheless, some challenges still remain. These include a lack of teacher training in using GIS on the Internet, a shortage of computer equipment, or the ‚ow level of access to the Internet at schools and in Geography classrooms in particular. New cartographical technologies offer advantages in the richness and diversity of resources, in the flexibility of use, its ease and immediacy, and the possibility of carrying out comparative analysis, etc., of didactic and curricular type. Thus, based on the work of GONZÁLEZ (2011) Geography teaching in the first year of secondary education (12 years old) should focus on representations, localizations, and characterizations, in the second year (13 years old) on explanations about social phenomena (demographic, economic and urban), whereas in third year (14 years old) to interpretations.

For example, in the first year of secondary education, a useful didactic resource taken from the digital climatic atlas of the Iberian peninsula may be the map of the rainfall in Spain where the students should be able to identify the two main climatic domains: humid Iberia from 800 mm of rainfall and dry Iberia, which at the same time comprises a semi arid area (rainfall of less than 400 mm). In this case, through the map, students should be able to learn geographical terms related to climate, to know the location of those phenomena and understand the representation of statistical data by means of maps of colours and patterns.

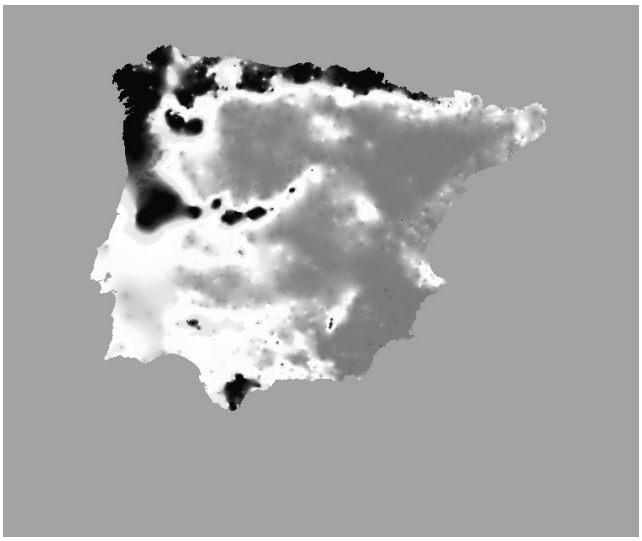

Fig. 1: Distribution of total annual rainfall in the Iberian Peninsula (Source: Atlas Climático Digital de la Península Ibérica)

In second year of secondary education, the map of population of Spain by municipalities, taken from the map viewer SIANE is a resource which serves, not only to represent and locate the main demographic concentrations, and the major gaps in population, but also to explain the processes of population distribution comparing different magnitudes.

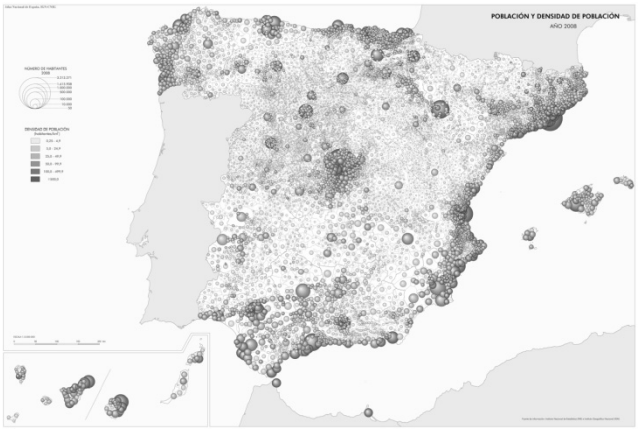

Fig. 2: Total population and population density by municipality in Spain (Source: SIANE)

The interpretation of geographical phenomena means the student is able to establish causes and consequences of the processes of land occupation. Thus, in the third secondary school year the map of the location of the different protected natural areas in Spain (through

different categories) implies a didactic resource of bigger complexity, where not only the different impacts of human activity on the natural environment are worked on (air, vegetation, rivers, soil, landscape) but also a synthesis of the multiple variables is carried out through establishing different solutions for the protection of the natural environment and values related to sustainable development.

Fig. 3: Protected Natural Areas in Spain (Source: IDEE)

This means that content from the concrete to the abstract should be worked on, from the local to the global in geographical terminology, and, of course, paying more attention to the usual procedures of the subject, in this case geography, among which cartographical techniques stand out. So, in the case of geography, the need to know about scientific techniques, such as cartography is undeniable, so that an adequate didactic treatment in transmitting geographical knowledge all along secondary education, taking into account the evolutionary and psycho-pedagogical development of the student.

In the official Spanish curriculum for secondary education, the terms 'map' and 'cartography' appear twenty-seven times. That is, cartography 'splashes' the entire secondary education curriculum, the geographical content and its treatment in the classroom involves most of the teaching and learning practices, in a progressive way. During the first years of secondary education, "reading and interpretation of images and maps of different scales and characteristics" is proposed, as well as "getting information from different sources available thanks to information technologies". However, in the last year of secondary education (17 years) the prescribed content for previous years is reproduced and expanded: "searching, getting and selecting relevant information for the geographical knowledge; direct observation, cartographical sources, statistical, visual, bibliographic and coming from information and communication technologies".

It is not unreasonable to think that, in treating cartography as offering conceptual and procedural content, some educational attitudes towards geographical space are implemented. In this way, teaching geography implies teaching students to be responsible

as far as the use of natural resources is concerned and fostering patterns of individual and collective behaviour concerning the protection and improvement of the environment.

Besides this, the curriculum stresses the importance of cartography in the acquisition of specific educational skills. So, the official text, refers to competence in the treatment of information and digital competence, where the understanding of geographical phenomena is conditioned with the skills relative to the treatment and understanding of information, including those obtained by means of information and communication technologies, and, especially, cartographic language. Similarly, the teaching of geography is conditioned to "find, select, understand and relate cartographic information, which comes from different sources, included the one provided by the physical and social environment, mass media and information technologies".

Finally, the criteria for curriculum assessment highlight the importance of cartography in geographic education: to locate, obtain information and characterize the space represented cartographically, use different sources, such as the cartographic ones to obtain, relate and process geographic information using the potential offered by information technologies, identify types of spaces and so that students learn to interpret territorial phenomena and their interactions.

4 Conclusion

In short, nowadays secondary curricula in Spain endorse the pedagogical didactic use of geographic information systems in the classroom. Among them, the ones available on the Internet, previously exposed, and which allow the geography teacher in Spain to have thousands of resources at different scales (from the global to the local, going on the national or European) to perform activities of geographical education linking geovizualisation, society and learning. And to open up many more possibilities respect to the digital cartographic revolution which is already changing the way of teaching geography in our schools.

Several ideas reinforce this conclusion: firstly, they are new resources, made available to the public on the Internet in very quick time. That means that they are didactical resources much appreciated by teachers and students since they involve a change from the traditional resources (textbooks, wall maps, cartographic records, etc.) and, consequently, they foster motivation for the learning of geography. Secondly, it is about cartographic databases that can be constantly updated thus providing resources which other conventional didactic materials such as textbooks do not offer. They also allow the landscape processes (demographic, economic, urban) to be analysed in near real time. Thirdly, we have checked that the different map viewers available in Spain cover most of all the geographical phenomena, either physical, human or regional (both related to the geography of Spain and the geographic study of the autonomous communities). The Spanish school curriculum follows a very similar structure to that of geographic science (natural environment and sustainable development, population, settlements and urban environment, economic activity and territorial organization, spatial imbalances) and, thus, the geographic media exposed in this work bear a close relationship with the organization of the curriculum.

Finally Map Viewers in Spain are good tools for learning geography in schools, although their use is still limited. It is clear that its diffusion and knowledge among Geography

teachers in schools must be increased. Geo-media resources must be used more often, and must be used better, by adapting digital maps to curricular content, but also through innovating and improving Geography teaching methods. The full versatility of WMS products brings cartography and geography closer to the student. To some extent, by these means personalized cartography based on the interests of the student can be carried out, in combination with the demands of the curriculum. The expanded use of such resources must deepen in the inductive methods of learning of Geography, from discovery learning to learning by doing, since a student able to create their own digital maps online, is able to comment on them, explain them and, ultimately, demonstrate that he or she has learned Geography.

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