Spatial Data Infrastructures as an Educational Resource in Secondary Education in Spain and Argentina

María Ester Gonzalez

University of Patagonia San Juan Bosco (Argentina)

Technical University of Madrid (Spain)

ester.gonzalez@topografia.upm.es

Abstract

Since the early 90s Spatial Data Infrastructures (SDI's) have attracted considerable attention from governments, private sector, academic organizations, etc. But, above all, the advance of Information and Communication Technology (ICT) has contributed to add new perspectives to the world of SDI's, thereby facilitating the access and exchange of Geographic Information at different levels, by means of its standardization and interoperability.

Latin-American countries stand at different development levels with regard to the implementation of their SDI's, both at national level and at local or regional government levels. Considering the growth perspectives of SDI's, it is necessary to contribute to a wider diffusion of their potential and use in different environments, both public and private. In this context the education environment appears as an area where action is needed.

Taking into account that current education should bring students closer to the new ICT tools, SDI´s appear to be a highly valuable education resource in order to deal with Geographic Information related contents in the context of secondary education. In order to consider this possibility, an assessment is needed of the students' academic competence and the basic common contents of the curriculum, so that the subjects where SDI's are to be used as an educational resource can be identified.

In order to build appropriate foundations on which to develop a future proposal in which SDI´s are considered as an education resource to deal with Geographic Information related contents, a study has been carried out of the secondary education in 2 countries that show great differences in SDI development: Spain and Argentina.

Introduction

Since the Spatial Data Infrastructures (SDI´s), in the early 90's, first received special attention by different public and private sectors, a great number of definitions have come forward in order to clearly explain the term.

"The term "Spatial Data Infrastructure" (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, and academia and by citizens in general". (Developing Spatial Data Infrastructures: The SDI Cookbook, 2004).

This definition of the term SDI mentions the different sectors taking advantage of spatial data availability for their evaluation and application in different contexts. Furthermore, we should add the advancement of the Information and Communication Technologies (ICT), allowing the access and interchange of Geographic Information at different levels through its standardization and interoperability

Hence, considering the prospects of SDI´s growth and their establishment as a paradigm for Geographic Information sharing in the Information Society context, the need for a greater dissemination of their potentials and uses is raised in various governmental, educational, and private spheres of activity. In particular, the educational scope turns up as a favourable field for SDI outreach through their utilization as an educational resource to address contents linked to Geographic Information.

This document examines SDI's as a possible educational resource to address the contents linked to Geographic Information in the context of the secondary education of two countries: Spain and Argentina.

First a brief portrayal of the secondary education of the countries is presented taking into account the current educational legislation: 'Ley Orgánica 7899 2/2006 of Spain' and 'Ley Nº 26206 de Educación Nacional de Argentina'.
(Both are Acts of Parliament).

Next a review is made of the common basic contents of the secondary education curriculum[1], the subjects or topics being identified wherein SDI's could be used as an educational resource.

1- General remarks

1.1- Secondary education in Argentina

The 'Ley 26206 de Educación Nacional', passed by the Congress of the Argentine Nation on December 14, 2006, enacted by the President on December 27 and published in the 'Boletín Oficial' Nº 31.062 of December 28, 2006, establishes that the secondary education is compulsory and makes up a pedagogic and organizational unit for the students who satisfactorily passed the primary education level.

The secondary education is split in two stages: a Basic Stage, common to all career orientations and an Orientation Stage, diversified in accordance with the different areas of knowledge, social world and work

For the purpose of this study, only the Basic Stage of the secondary education is considered.

1.2- Secondary education in Spain

The 'Ley Orgánica de Educación 7899 2/2006, of May 3, 2006, published in BOE Nº 16 (05/04/2006), establishes, in the Preliminary Title – Chapter II: Teaching Organization and Learning throughout Life, article 3.3, that the basic education is made up of the primary education and the compulsory secondary education. Article 3.4 breaks down the secondary education into Compulsory Secondary Education ('Educación Secundaria Obligatoria' – ESO), post-compulsory secondary education ('Bachillerato'), midlevel professional training, professional teaching of the plastic arts and design and midlevel sport teaching.

For the purpose of this study, only the Secondary Education (ESO) is considered.

2- General aims of the secondary education and its linkup to SDI's

Both the Spanish and Argentine legislations in the matter of education highlight the need of bringing the ICT closer to the students. Here is the favourable area for the SDI's to be shaped as one of the educational resources offering the possibility of using, assessing and applying the geographic information, at the same time utilizing the ICT.

2.1. General aims in Spain

The Spanish 'Ley Orgánica de Educación' establishes a number of general principles, aims and targets for the Secondary Education, among which the following stands out:

"To develop basic skills in the use of information sources with the end of critically acquiring new knowledge. To gain a basic training in the technological field, especially in the information and communication technologies" ('Ley Orgánica de Educación' – Title I – Chapter III – Article 3 – e)

Within the framework of development of those basic skills, the use of SDI's may be considered as a tool bringing the students closer to the ICT world.

On the other hand, the European Union has identified 8 basic capabilities for the secondary education, among which, for the purpose of this document, number 4 stands out, namely the handling of information and digital skills. These aptitudes basically consist of having the capability of searching, obtaining, processing and communicating information, turning it into knowledge. This implies the integration of varied capabilities, including the access to the transfer of information, using the ICT to inform, learn and communicate. Likewise the digital skills imply the regular utilization of technological resources for the efficient solution of problems of the real world, making an assessment and a selection of the new information sources and technological innovation coming up, in order to use them in specific tasks and objectives. In this context the SDI's appear as one of the educational resources offering multiple alternatives to be exploited, so contributing to the achievement of the necessary digital capabilities.

2.2- General aims in Argentina

The 'Ley de Educación Nacional Argentina' brings up a number of objectives linked up with ethical and civic education, the advancement and strengthening of students in the

areas of study, learning and research, both individually and in a group, the development of linguistic (both oral and written) capabilities, linking of students with the working world and production, science and technology, etc. For the purpose of the present document, the following aims are emphasized: "To educate responsible persons capable of using knowledge as a tool to understand and constructively transform their social, economic, environmental and cultural milieu, becoming active participants in an ever-changing world" ('Ley Nº 26.206 Ley de Educación Nacional' Chapter IV- Secondary Education, Article 30 - b).

"To develop the necessary capabilities for the understanding and intelligent and critical utilization of the new languages coming from the field of the information and communication technologies" ('Ley Nº 26.206 Ley de Educación Nacional' Chapter IV- Secondary Education, Article 30 - f).

It is said that Geographic Information is an essential component facilitating the processes of decision-making (economic, social, political, environmental, etc.) and that an SDI unifies the processes related to that information, offering accessibility to Geographic Information through the Internet. It is necessary for the students to be aware of the possibilities offered by the SDI's as one of the new languages produced by the progress of the ICT, so that in the future the students will take advantage of those possibilities in the process of decision-making, hence contributing to constructive transformation of their social, economic, and environmental milieu.

3- Common basic contents of the secondary education curriculum

3.1- Common basic contents in Spain

An article 24.1 and 3 of the Spanish 'Ley Orgánica 2/2006' establishes the following compulsory subjects of the first to the third year of the Compulsory Secondary Education (ESO):

- Natural Sciences
- Physical Education
- Social Sciences, Geography and History
- Language and Literature (in Castilian Spanish or in two languages equally recognized as official when applicable)
- Foreign Language
- Mathematics

ESO subjects in which SDI's may be utilized as an educational resource are various. The contents may be addressed with either direct o indirect referencing of location in a spatial context, i.e. requiring geographic information.

The compulsory subjects offering a favourable area for SDI utilization as an educational resource are the Natural Sciences, the Social sciences, Geography and History and Technology, which according to the contents may offer different possibilities as explained below.

- **Natural Sciences:**

The categorization and knowledge of the natural world involves not only the building of concepts and the searching of relationships among them, but their location in a geographic context is also necessary. To get to know and value the natural environment first means to get located and then to get informed, to experience, to observe, etc. The study of ecosystems with a dynamic approach and the environmental

problems require the use of tools as a part of the ICT, among them the SDI's constitute an alternative worth consideration and exploitation. For instance, by using the map server of the Spatial Data Infrastructure of Spain (IDEE), the layers of protected sites may be added (natural parks, natural reserves, protected landscapes, etc.) Thus the student will use a dynamic tool providing up-to-date information, he/she will search for information by defining the layers he/she will add (select), and he/she will process the information that will be presented in different ways.

Likewise a contribution is made to the aspect of digital capabilities. The student uses the ICT in the learning of this subject, and this allows the student to communicate, to capture information, to feed back, to simulate and visualize and then handle that information, transform it to knowledge and make decisions. Block 1 (Common Contents) of the first year includes the utilization of communication media and the information technologies to select information about the natural environment, as well as the interpretation of data and information on the nature. Here SDI utilization as an educational resource is feasible in order to address the proposed contents, at the same time using the ICT.

During the second year the information is selected using the communication media and the information technology (same as in the first year) but the search is directed to natural phenomena.

In block 6 (The Natural Environment) of the second year, among the proposed contents, the carrying out of simple investigations about a surrounding ecosystem stands out. Thus, if we consider the SDI's as a resource to be applied in the development of this particular content, the utilization of a map server may be useful to locate the ecosystem by overlaying natural resource layers.

As in previous years, in the third year the utilization of ICT for the search and selection of information is again mentioned. In block 6 (Persons and the Environment) SDI's might also be used, since among the contents the following are emphasized: natural resources and their types, sustainable use and management of resources, current, main environmental problems, etc. In order to address these contents, the local, regional or national SDI's may provide the necessary information.

- **Social Sciences, Geography and History:**

In the Social Sciences, Geography and History knowledge of the society is searched for taking into account its spatial dimension, its territorial make-up, bringing closer to the students the processes and outcome of the interaction between society and physical environment. Thus "… the principles of interaction between society and physical environment are brought closer to students, enabling the assessment of men's actions in space and the potential and constraints of the milieu" ('Real Decreto' 1631/2006, Annex II, p. 26)

In the first year the natural media and domains are studied, both the social interaction and the territorial make-up, in reference to the world space and with a greater detail the Spanish and European space. Within the common contents the reading and interpretation of images and maps at different scales and with different characteristics are emphasized. Here the cartography provided by the SDI's with their metadata may be used. This is reinforced in Block 2 (The Earth and Natural Environment) as follows:

"Location and characterization on maps of continents, oceans, seas, relief and rivers in the world, in Europe and in Spain. Location and characterization of the main natural

resources, with special attention to the Spanish and European territories". ('Real Decreto' 1631/2006, Annex II, p. 29)

The block 'Population and Society' of the second year is the one providing more opportunities for utilization of the SDI. Its different services could be used for analysis of urban space, urban hierarchies, function and spatial identification of urban structures, urban issues and Spanish cities.

In block 1 (Common Contents) of the third year one can read:

"Obtaining and processing of both explicit and implicit information from perception of the surrounding geographic landscapes or from images, oral sources and visual, cartographic and statistical documents, including the ones provided by the information and communication technologies". ('Real Decreto' 1631/2006; Annex II, p. 31)

In block 2 (Economic Activity and Geographic Space) the contents linked up with the impact of economic activity in space are addressed, whereby the appropriate cartography will be required for location and characterization of the main areas and centres of economic activity.

Block 3 (Political Organization and Geographic Space) and block 4 (Transformation and Imbalances in the present-day World) also provide a good opportunity for use of the SDI's, since geographic information is required in order to address the different contents involving political and administrative organization, regional imbalances and environmental issues.

On the other hand, in the third year one of the evaluation criteria stands out, namely the identification and finding of the 'comunidades autónomas' (autonomous regions) and their capitals on the map of Spain.

Finally the fourth year emphasizes History. Here the use of cartography is always present since every historical event or fact conveys a spatial location. In particular, we will mention the use of the SDI's in block 3 (The present-day World).

- **Technologies**

As mentioned in the introduction of this subject, "The education of citizens currently requires a specific attention to the acquisition of the necessary knowledge to make decisions on the use of technological objects and processes, to solve problems related thereto and, in short, to use different technological materials, processes and objects to enhance the capability to act on the surrounding milieu". ('Real Decreto' 1631/2006, Annex II, p. 90)

The important role played by the use of the ICT in this subject, their utilization and handling and the integration with the other disciplines provide an opportunity for the student to access the SDI's through the use of the Internet, along with other more specific subjects.

3.2- *Common basic contents in Argentina*

The 'Ley 26206, de Educación Nacional', passed by the Congress of the Argentine Nation on December 14, 2006 establishes for the secondary education a common basic stage which would correspond to the Third Stage of the 'Educación General Básica' or EGB 3 of the Federal Law of Education nº 24.195, passed on April 1993.

Therefore the recent approval of the 'Ley de Educación Nacional' has not allowed the reformulation of the Common Basic Contents (CBC) as yet and the contents of the old EGB 3 are still in use.

The CBC for the EGB is presented in chapters with arrangement of the contents according to their assignment to certain scientific or cultural fields. The chapters are:

- Language
- Mathematics
- Natural Sciences
- Social Sciences
- Technology
- Artistic Education
- Physical Education
- Ethical and Civic Education

In the chapters of Natural Sciences, Social Sciences and Technology are blocks with contents in which the SDI's may be used as one of the educational resources. They are as follows:

- Natural Sciences:

The selected contents for the Natural Sciences come from the fields of Physics, Chemistry, Geology and Biology. They are arranged in six blocks. The contents susceptible of being aided by the use of the SDI's as an educational resource are scarce.

In block 1 (Life and Its Properties) SDI's might be used for conceptual contents linked to human activities and their environmental impact as well as natural resources.

In block 4 (Earth and Its Physical Changes) the practical contents include cartographic reading, reading and interpretation of satellite images and air photos. Here the utilization of the SDI's as an education resource appears to be suitable.

- Social Sciences

Here the CBC gathers together contributions from History, Geography, Sociology, Economy, Anthropology and Political Science. In the proposed contents multiple levels are considered: regional, national and American, with basic references to the worldwide level. Attention is paid to the systematic comparative analysis of other fields of application besides urban/rural, e.g. village/town/big city. Furthermore the identification and assessment of the problems associated to the deterioration of the environment, of great territorial scope, are studied in further detail

Here the opportunities of using the SDI's as an educational resource are broad, when we consider that, although a nationwide SDI has not been completely developed yet (it is still in process), different SDI's may be used existing at the American level and worldwide.

Block 1 (Society and Geographic Space) is the one presenting various contents susceptible of being aided by the use of the SDI's as one of the educational resources. Among the proposed conceptual contents the following stand out:

- Absolute and relative location. Geographic coordinates
- Cartographic materials of different types and scales

In block 1 the natural resources are also addressed, studying their location and assessment as well as the environmental issues at different scales, all of which demand the use of cartography. The contents related to urban and rural landscapes, contrasts and connections also require the use of cartography and of different cartographic sources.

The conceptual contents related to transportation provide another area for use of the SDI's as an educational resource, especially concerning networks, movements, transportation flows, spatial distances, distances and accessibility, situation of residential settlements and location of economic activities.

The conceptual contents related to political organization of the territory at different scales, especially concerning borders and location, all allow the use of SDI's map servers.

- Technology

Since technological literacy is a priority and the progress of the ICT has enabled SDI growth, it is essential to acquire knowledge for use in other subjects.

Block 3 (Information and Communication Technologies) appears to be the most appropriate for SDI use. This block makes it imperative that the students acquire the capability of using the technology to access, analyze, filter and organize multi-dimensional information sources. They should succeed in handling information, its storage, location and retrieval, including indexing, catalogues, libraries, etc. This is a block broad enough to consider the SDI's as one of the educational resources allowing the student to achieve the desired capabilities by means of work integrating other knowledge areas.

Conclusion

In the educational field, ICT use to address the topics linked up with Geographic Information become very effective tools which somehow facilitate the process of teaching-learning. Although ICT incorporation in the class is very slow, actions are being brought forward to speed it up. It is a demand of the Information Society. In this context, the use of SDI's as an educational resource offers great possibilities that should be taken advantage of.

When taking into account the differences of development of the SDI's in the countries subject of this study, Argentina and Spain, the possibilities of using SDI's available at different levels of analysis in the context of secondary education are very dissimilar.

In Spain the national SDI has undergone an important development. Same holds true of some 'comunidades autónomas' and regions of Spain which already have their SDI, so their use in education only requires specific actions contributing to SDI dissemination and the education and training of teachers, so that they become aware of their potential and uses to address contents related to geographic information.

At the present time Argentina has PROSIGA (Geographic Information System Project of Argentina) which started out as an Internet distributed GIS. In 2006 it was reformulated and it was proposed as the basis for development of IDERA (Spatial Data Infrastructure of the Republic of Argentina). The dissemination of a project that is becoming consolidated is very important, especially if its value as an educational resource is stressed. On the other hand the current reformulation process of the CBC

offers a favourable area for inclusion of contents allowing a greater utilization of the SDI's as an educational resource in those knowledge areas with contents related to geographic information.

A great challenge for the institutions having the responsibility of SDI implementation is to carry out an integration within the formal learning –more specifically in the secondary education— of the SDI's as an educational resource to be effectively used in different contents or subjects where geographic information is called for.

Review of the curriculum common basic contents and identification of those subjects or topics in which SDI's could be used as an educational resource is a starting point for definition, in the future, of didactic proposals to address the contents related to geographic information. Thus a double objective will be fulfilled: to bring students closer to the ICT world and to the SDI world.

References

Biblioteca Central de la Universidad Nacional de la Patagonia San Juan Bosco
http://www.biblioteca.unp.edu.ar/bibliop/educacion.htm

Developing Spatial Data Infrastructures: The SDI Cookbook, 2004
Editor: Douglas D. Nebert, Technical Working Group Chair, GSDI

Dirección Nacional de Gestión Curricular y Formación Docente – Ministerio de Educación de la Nación Argentina - Contenidos Básicos Comunes (CBC)
http://www.me.gov.ar/curriform/pub_cbc.html

Diseño curricular EGB 3
http://www.chubut.edu.ar/dis_curric/dis_curric.html

Gobierno de Argentina
http://www.argentina.gov.ar/argentina/portal/paginas.dhtml?pagina=141

Gobierno de España – Ministerio de Fomento – Consejo Superior Geográfico – Infraestructura de Datos Espaciales de España
http://www.idee.es/show.do?to=pideep_pidee.ES

Information and Documentation Centre
http://infoleg.mecon.gov.ar/

Ley de Educación Nacional Nº 26.206 (Argentina)
http://debate-educacion.educ.ar/ley/ley-de-educacion
nacional/ley_de_educacion_nacional_n.php

Ley Orgánica de Educación - Ministerio de Educación y Ciencia (España)
http://www.mec.es/educa/index.html
http://www.mec.es/mecd/gabipren/documentos/A17158-17207.pdf

Ministerio de Educación Ciencia y Tecnología de la Nación Argentina
http://www.me.gov.ar/

Proyecto Sistema de Información Geográfica de la República Argentina
http://www.sig.gov.ar/l