

VIRTUAL DIVIDE, BOLOGNA EDUCATION MODEL AND GEOGRAPHIC INFORMATION TECHNOLOGIES

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ABSTRACT

The following report deals with the concept of *digital divide*. It is pointed out the importance of this type of segregation in the information society we live and it is showed how education and training has been considered the unique way to avoid it. In this sense, it is also emphasized the chance that the European Union has to face this coming trouble at this particular time. The definition of a new education system at the European Higher Education Area (EHEA) based on lifelong learning philosophy and the Bologna principles give us a new educative context. Geographic Information Technologies (GIT) are presented as an example of expertise that can generate digital segregation in the nearest future making a final point about how the new postgraduate courses related to GIT should be define at the European universities.

Key words: Digital Divide, Bologna Agreement, Lifelong Learning, GIT.

RESUMEN

El presente artículo reflexiona acerca del impacto que el desarrollo tecnológico tiene en nuestras sociedades. A lo largo del primer apartado se señala la importancia que la segregación digital tiene en la actual sociedad de la información, confirmándose posteriormente el hecho de que la formación es la única respuesta válida para evitarla. En ese sentido, se enfatiza la oportunidad histórica que la Unión Europea tiene de cara a integrar en su nuevo Espacio de Educación Superior (EEES) soluciones que minimicen este impacto. Las tecnologías de la información geográfica (TIG) son presentadas como un ejemplo de tecnologías que puede generar este tipo de segregación en el futuro próximo, planteándose la necesidad de una reflexión seria acerca del modo en que deben de ser diseñados los programas de futuros cursos postgrado relativos a las TIG.

Palabras clave: segregación digital, acuerdo de Bolonia, educación continua, TIG.

1. Introduction

The current report is one of the first outcomes of a research project developed in the GIS laboratory in Trinity College Dublin since September 2004 in response to the Bologna process title "Creating a lifelong learning framework for geographical information systems education: circumventing a digital divide" that explores and aims to clarify one of the most important problems in our society today called *digital divide*. Through this report it is made a reflection in relation to the impact that the digital revolution we are involved in, affects to the way we leave and to the way we learn.

Firstly, the nature of this complex problem is presented in order to frame it and several examples are given of what this concept means in the real life. Secondly, the causes for the creation of this divide are investigated to determine the roots of the problem. Thirdly, policies for the avoidance of the digital divide are given for governments and social organizations. Fourthly, these policies are examined in relation to the education model being developed in Europe at present under the Bologna umbrella. Finally, it is particularized this fact attending to Geographic Information Technologies and scientific skills. The framework of this report is given in [Figure 1](#).

2. Digital divide

The term 'digital divide' describes the discrepancy between people who have access and the resources to use new information and communication tools, such as the Internet, and people without these resources and access. The term also describes the discrepancy between those with the skills, knowledge and abilities to use the new technologies and those without.

The digital divide exists between those in cities and those in rural areas. For example, a 1999 study showed that 86% of Internet delivery was to the 20 largest cities (Gehrt Kennethy Ruoh-Nan, 2003). The digital divide also exists between the educated and the uneducated, between economic classes, and, globally, between the more and less industrially developed nations. Digital divide is present when someone is unable to buy a ticket for a train on an automatic teller machine or when they experience difficulties in using a microwave.

Information and Communications Technology - or Technologies (ICTs) is an umbrella term which includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with these.

The digital divide defers depending on the field we are concerned with. For instance, from a social point of view (Hayes, 2005), it is related to the wide space that is opened between people who have the ability to work with ICTs and those without. From a psychological point of view, the consequences of the digital divide on an individual can be result in frustration, anxiety, reduction in self confidence and social exclusion (Bessiere, *et al.*, 2002). This can happen at home, at work or at school. On the other hand, in many cases, new technologies give us the opportunity to rethink a problem and they offer a great potential to redesign learning processes.

Behind new technologies is also the idea of competitiveness. Any technological improvement implies a competitive advantage; a crucial point in the modern world. In this sense, it seems obvious that those who do not implement these new ICTs in their tasks will lose their capacity to compete effectively with others (Servon, 2002). The existing gap between new ICTs and our capacity to use them in a comprehensible way is becoming widening each day in a number of ways.

3. Proposed Solutions

Many of the new technologies developed in recent decades are based on computers as instruments to process data. As John Merrow (1995) states in his article "*Obstacles to a technological revolution*" our society uses the computer as the central tool for communicating and creating knowledge. This is highlighted by the fact that "*in some countries, it is a statutory requirement that all of the trainee teachers follow a National Curriculum in Information and Communication Technology and pass an ICT skill test*" (Butt, 2002).

There is general agreement about the solution to the digital divide: further education. Learning is the main way to overcome the digital divide (OECD, 2000). Learning process can be developed in many different ways:

Formal education is defined as the highly institutionalized, chronologically graded and hierarchically structured 'education system', spanning lower primary school and the upper reaches of the university.

There is also a *non formal* education that can be understood as any organized, systematic, educational activity carried on outside the framework of the formal system to provide selected types of learning to particular subgroups in the population, adults as well as children (Coombs and Ahmed, 1974).

Commercial teaching and training could be included in this group. Many enterprises invest tremendous amounts of money (Microsoft, Motorola, Mercedes...) in training to their employees because it is known that this is the best venture they can do nowadays to improve their competitiveness.

Informal education is the lifelong process by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to the environment - at home, at work, at play; from the example and attitudes of family and friends; from travel, reading newspapers and books; or by listening to the radio or viewing films or television (Coombs and Ahmed, 1974).

Any answer proposed for the digital divide within formal education in Europe should be framed under the new education model is being defined by the European Union. In this sense, important changes are taking place nowadays. The development of the European Higher Education Area (E.H.E.A.) is a clear example of this.

3.1. The new education model in Europe and digital divide

The concept of *Lifelong Learning* has become the main theoretical framework for the new education model in the European Union. European Council Resolution of 27 June 2002 on lifelong learning (2002/C 163/01) stresses that: "*lifelong learning must cover learning from the pre-school age to that of post-retirement, including the entire spectrum of formal, non formal and informal learning. Furthermore lifelong learning must be understood as all learning activity undertaken through life with the aim of improving knowledge, skill and competences under within a personal, civic social and/ or employment related perspective*".

The World Bank gives us a clear comparison between the characteristics of the traditional and the lifelong learning models ([Table 1](#)).

It has been recently reported (CEDEFOP, 2004) that the main competences to live and work in a knowledge society are: "*Communication in the mother tongue; communication in a foreign language; mathematical literacy and basic competences on sciences and technology; **ICT skills; Scientific-technological skills an equipment**; learning-to learn; interpersonal and civic competences; entrepreneurship (creativity and being able to take initiative) and cultural awareness*". ICT skills are considered in this report and they must be understood as the ability to use a computer or to use the Internet while scientific-technological skills refer to the ability to use scientific and technical tools.

It has also been established that "*knowledge has become the central key resource that knows no geography*" (Drucker, 1993). The largest working group will become what it is called *knowledge workers*. The defining characteristic of these *knowledge workers* is the level of their formal education. Thus, education and development, and to some degree training, will be the central concern of a knowledge society.

Traditionally, *formal education* in Europe has been defined by each country. The degrees that are obtained in many European countries have the same name but there are important differences in relation to the structures of the courses, their content, the social value given to the same degree, the number of teaching hours, etc.

The key point, in this matter, is related to the definition of a new education model in Europe that can normalize the wide diversity of systems that live together nowadays in the old continent (Martin-Vide, 2004) under the Lifelong Learning principles.

In relation to this aim, there have been a huge number of meetings, agreements and declarations ([Table 2](#)) over the last few years. The core tenets of these agreements can be summarized as follows:

- Defining a new system of *easily readable and comparable degrees* in Europe. According to the Bologna agreement, a new system of "*transfer and accumulation credits*" denominated European Credit Transfer System (ECTS) is being established in most of the European universities. Many of them are used to work with credits but the new ECTS are not based on the idea of *teaching time* but on the *students workload* is required to achieve the

objectives (Objectives should be expressed in terms of the learning outcomes and competences to be acquired by the student) of a specific program. The ECTS will not make sense if we are not able to identify common learning outcomes to make the ECTS really comparable.

- A second point refers to *the structure of the studies*. A system essentially based on two main cycles, graduate and postgraduate has been defined. Some countries are used to this system and others will assume it in the future. The first one will take the student to get a Bachelors Degree. It will be necessary to get between 180 and 240 ECTS (three or four years). The second one is a Master degree and it has to be searched between 90 to 120 ETC (in same cases can be even 300 ECTS). A Masters degree should be the first door to access to the PHD studies.
- *Quality assurance and accreditation* at a national and international level has become a crucial point in the agendas of the countries. At the Communiqué of the Conference of Ministers responsible for Higher Education in Berlin on 19 September 2003 was stressed "*the need to develop mutually shared criteria and methodologies on quality assurances*" and also that "*consistent with the principle of institutional autonomy the primary responsibility for quality assurance in higher education lies with each institution itself*". It was also agreed that by 2005 national quality assurance should include:
 - *A definition of the responsibilities of the bodies and institutions involved.*
 - *Evaluations of programs or institutions, including internal assessment, external review, participation of students and the publication of results.*
 - *A system of accreditation, certification or comparable procedures.*
 - *Internal participation, co-operation and networking.*
- The last point in relation with this process is related to improve *the recognition systems of degrees and periods of studies*. At this point all Ministers commit themselves to having started the implementation of the two cycles at the higher education system in Europe by 2005. The members were encouraged to "*describe qualifications for their higher education systems in terms of workload, level, learning outcomes, competences and profiles*".

It has been established that higher education development in Europe should also attend to the social and cultural dimensions. It was accepted that the result of the EHEA should also be a place where the values and social and cultural heritage be shared by everyone. However, if we examine the Report to the Minister of Education of the signatory countries on Prague, May 2001 title *Furthering the Bologna Process*, we discover that "*the lifelong learning is far from being generally identified as an integral part of higher education and is a priority only in a limited number of countries*".

An enormous effort is being done by the students, the academics, administrative workers and staff at upper learning-education centers (universities, faculties...) for being able to affront the new education model that is proposed by the EU policies. In [Table 2](#) have been synthesized the general statements of several meetings related to it.

The process of standardizing must be carried out at three levels: theoretical, practical and technical levels. In this way, some new degrees programs can be directly related to the *digital divide* that was mentioned before. Now it is a perfect time to stop and rethink how and what we teach in the EHEA and what training is given to professional workers and how it is related to the different areas in which *digital divide* may be presented.

4. Geographic Information Technologies

4.1 A wide diversity

Geographic Information Technologies (GIT) are a relatively new group of information technologies (IT) which work with geographic datasets. They have their own velocity of growing and are on the way of getting more popular each day.

Many public services (gas, electricity, transport...) and governments have decided to invest in corporative GIT to manage all the spatial and non-spatial information they have. Private companies (engineering, environmental, marketing, health...) which know about these new technologies are also demanding qualify workers to manage their spatial databases and to develop new services for customers based on these new tools.

In the nineties, Network Services (NS) were spread all over the world. Web services have supposed a tremendous impact not only in the virtual world but in the real one. The idea of standardizing the access to information was the main consequence of this development. This event has also affected to the GIT in the sense of creating the need of defining a Spatial Data Infrastructure (SDI) <http://www.foroгеoinformatico.com/historico.html> that makes possible sharing spatial information in one specific country or all over the world.

In 2004, at the opening of the National Center for Geocomputation (NCG) in Ireland, Michael Goodchild said that the first decade of the XXI century is being the Global Positioning System (GPS) decade. The generalization of this new technology has become a fact at the USA society and is becoming wider and more famous at the European one as can be seen through the Galileo initiative (ESA, 2006).

Nowadays we know where things and people are not only using the normal GPS but also right through the mobile phone calls or even throughout the electronic transactions are generated every day with the credit cards.

Geographic Information System (GIS) has been able to integrate, in the last decades, many different technologies (Longley, *et al.*, 2005) that were born with different aims a long time ago such as Computer Aided Design (CAD), Data Base Management Systems (DBMS), and spatial analysis techniques.

There has also been a clear integration between GIS and the Remote Sensing technologies (Chuvienco, E. 2002). Most of the algorithms that work with radiance are been integrated in Spatial

Geo-referenced Data Based Management Systems. In fact remote sensing has become the main data source for the Geographic Information Systems.

There are many authors who have referred to this process as a constant process of integrating several technologies in one. Some of them (Thurston, *et al.*, 2003) talk about it, very accurately, as the integration of the geo-spatial technologies and describe the "Geo-Technology Timeline" in relation with this topic.

It seems that the spatial dimension of human events is going to be present in our studies more than has never ever been in the human history due to the fact that we have the ability to register that information. Recently an article by Brendan Nolan (2004) was published at The Sunday Business Post who invited the companies to 'unlock the hidden value of data' in relation with geographic information.

2.2 GIT and Digital Divide

The inaccessibility and lack of ability to use GIT can be considered nowadays as a specific example of a technological skill that promote *digital divide* at different levels in our society. The digital segregation can be even more important in this particular case when we talk about GIT as a *scientific and technological skill*. The aptitude to use scientific tools related to GIT are very well valued in many research groups.

In this sense, GIS and its related technologies are provoking a new clear *digital divide* in the business world and also at scientific spheres. According to the preliminary results of a survey that has recently been developed at the GIS labs at Trinity College Dublin (Fernandez de Arroyabe and McCarron,, 2005) more than 65 % of people who have participated in any activity (teaching, lecturing, researching) related directly or indirectly to GIT consider that the degree in which these new technologies will generate digital divide will be *high* or *very high*.

As it was said before, the answers to avoid the *technical and scientific digital divide* in this particular case related to geo-information technologies should be teaching and training. This obvious answer has been given by several authors before in the US (Kemp and Wright, 1997) who considered that "improving GIScience education requires the specification and assessment of curricula for a wide range of student constituencies".

The *Model Curricula Task Force*, chaired by Duane Marble, was formed in 1998 and in 2003 it issued *The Strawman Report* where an ambitious vision of national-scale curricular report for GI S&T undergraduate education in the United States is presented.

More recently, the Education Committee at the University Consortium for Geographic Information Science (UCGIS) have integrated the original aims from the Strawman Report into a wider reflection about GI Science and technology field through its *Body of Knowledge* (DiBiase, *et al.*, 2005-06).

Fernández de Arroyabe Hernández, P. (2006): "Virtual divide, Bologna education model and geographic information technologies", *GeoFocus (Informes y comentarios)*, n° 6, p. 39-51, ISSN: 1578-5157

All these works are clearly related and can help to deal with actual changes that are taking place in the European Higher Education System in relation with graduate and postgraduate courses on GIT.

Lecturers who have traditionally been teaching some of this GIT such as GIS, have found that the theoretical ideas related to map edition and spatial analysis they are used to manage have become a minimum part of a new complex and wide technology not only in relation with processing geographic information but also with the communication technologies at different levels.

2.3 GIT courses and Bologna Model

Several universities all over Europe offer undergraduate courses related to some GIT such as Geographic Information Systems (GIS), Global Positioning Systems (GPS) or Remote Sensing (RS). Some of them have developed postgraduate courses (certificates, diplomas and masters) in the use an application of these geographic technologies.

It is occurring a clear diversification in the offer of courses in order to apply GIT to a wider spectrum of knowledge areas trying to cover the increasingly demand in different fields (planning, environmental studies, civil engineering, geo-marketing, health, archeology, transports, making decisions, services management, map productions, building management...). "*Applications of GI S&T are increasing diverse, increasingly critical to organizational missions, and increasingly tightly integrated with organizations' information infrastructures*". At this point, it can be said that the specialization level that has been achieved is relatively low in relation with the existing potential demand.

The question at this point is related to how many of these courses have been designed under the Lifelong learning ideas and the Bologna principles.

Trinity College Bologna Desk internal report mentioned before shows that there is a wide number of formal and non formal GIS courses all over Europe. Nevertheless, only a few of them seem to have been designed taking into account some of the basic principles of the lifelong learning philosophy that promote the theoretical frame of Bologna agreement.

In this sense, if new technology generates digital divide, there is an important chances to use GIT as a pilot project all over Europe in order to evaluate the new education model and validate the match between the new GIT courses programs designs (undergraduate and postgraduate) to the principles there are behind the lifelong learning philosophy and the Bologna process taking into account that GIT represent an important learning skills to Bologna.

5. Conclusions

Two different realities have been described through this preliminary report. On one hand, it has been showed that *digital divide* is present in many different forms at many different levels in our society and teaching and training is the only means of avoidance. On the other hand, the effort to create the EHEA in relation with a new model of education will be a key factor for the future competitiveness. Geographic Information Technologies is an example of how digital divide can affect the professional and scientific fields.

In this sense, new specific skills related to GIT have entered into the professional and scientific landscape. A new increasing demand to use this technology has appeared. At this point, the Bologna education model at European universities and the new workforce demands should come together in what it has been called the knowledge society.

Nevertheless, most of the formal courses related to GIT that are offered today have not been defined under the *bologna criteria*, (objectives, new skills, employability, lifelong learning, students mobility, e-learning...). These old courses should migrate into the new education model at least at the EHEA and the new postgraduate courses on GIT should be designed at an international scale, in two or three different languages, promoting staff and student mobility and considering courses on other kind of skills (social, communication or management skills).

Innovative and fresh methodologies of teaching and training quality evaluation should be developed and applied according to the Bologna aims in order to ensure that any comparison is fixed to common indicators in this area in line with the contents of the *Standards and Guidelines for Quality Assurance in the European Higher Education* document (ENQA, 2005)

Initiatives such as the one that is being expanded at the European Education in Geodetic Engineering, Cartography and Surveying, EEGECS, are a good example in order to define standard *curricula* in this field <http://www.top.upv.es/eegecs/main.asp>

Developing of the EHEA is closely linked to the new skills that have been identified in European society. If the new education model is not assumed, we may narrow the digital divide but will not approach to the knowledge society.

There is no doubt that acquiring new GIT skills is very important but we should not forget that understanding geographical concepts and getting knowledge must be on the base of any geo-technical ability.

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TABLES

Table 1 - Characteristics of the Traditional and Lifelong Learning models

Traditional Learning	Lifelong Learning
The teacher is the source of knowledge	Educators are guides to sources of knowledge
Learners receive knowledge from the teacher	People learn by doing
Learners work by themselves	People learn in groups and from each other
Tests are given to prevent progress until students have completely mastered a set of skills and to ratio access to further learning	Assessment is used to guide learning strategies and identifying pathways for future learning
All learners do the same thing	Educators develop individualize learning plans
Teacher receive initial training plus ad hoc in-service training	Educators are lifelong learners. Initial training and on-going professional development are linked
"Good" learners are identified and permitted to continue their education	People have access to learning opportunities over a lifetime

Source: World Bank (2003:29) Lifelong Learning in the Global Economy: Changing for developing Countries, Swindon: Washington, D.C.

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Table 2 - Main event in the Bologna Process

Date	Agreement	Countries	Main Aims
25 May 1998	The Sorbonne declaration on harmonization of the architecture of the European higher education system	France, Germany, Italy and U.K.	The seed of what we now call the Bologna Process related to the creation of a European Higher Education Area (E.H.E.A.)
June 1999	The Bologna Agreement	29 Education Ministers	To reform and integrate the structures of their higher education systems in Europe
22 - 25 of March 2001.	The Students Goteborg Declaration	Students Goterborg Conventions	It referred to the involvement of students in the process of constructing a real E.H.E.A.
19 May 2001	The Prague Declaration	32 European Countries	To review the developments that had been carried out since Bologna in relation with the main goals of Bologna Declaration (international competitiveness, mobility and employability)
12 – 13 March 2002	Seminar: Working on the European Dimension of Quality. Amsterdam.	Center for Higher Education Policy Studies (C.H.E.P.S.)	Quality assurance and accreditation at a national and international. The recognition systems of degrees and periods of studies
19 September 2003	Conference of Ministers responsible for Higher Education	33 European Countries	Quality assurance and Accreditation And Improving the recognition systems of degrees and periods of studies.
19-20 May 2005	Conference of European Ministers Responsible for Higher Education	45 countries	Ministers took stock of the progress of the Bologna Process and set directions for the further development

Source: <http://www.dfes.gov.uk/bologna/>

FIGURES

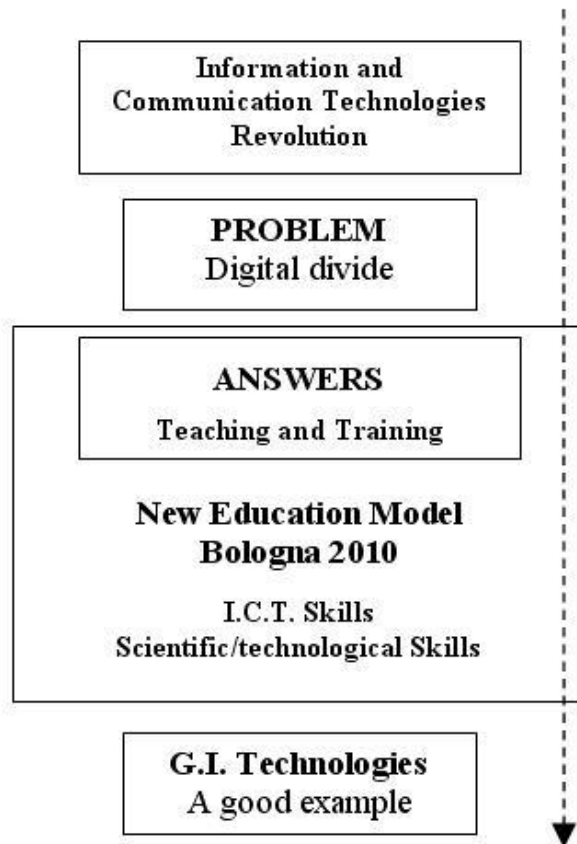


Figure 1. Framework of Report