SUMMARY
Scientific and technological evolution drives the growth of our society. Today one of the main efforts carried out by national governments and international institutions, is to “take science out of the lab and into the public arena”. The European Commission states: “The Science and Society theme within the European Research Area supports activities that bring together policy-makers, researchers, and citizens.” (EC ERA).

As press, TV, radio and Internet can be used as communication channels between scientists and non-scientists, so to “take science out of the lab…”; the e-learning courses can be used as scientific literacy tools to spread more organized and well-constructed scientific knowledge.

The paper describes the distance learning SIGEO (GEOgraphic Information System) course as a Dissemination Scientific Information achievement devoted to promote a Geographical Information (GI) dissemination as well as a more conscious Geographic Information Systems (GIS) use.

KEYWORDS: Geographic Information, Geographic Information Science, distance learning, education and training, e-learning.

INTRODUCTION
The fast technological changes and science evolution require continuous professional updating, so continuous education and training become key factors: the need for knowledge and training lasts a whole lifetime both at the personal and at the professional level (EU White paper, 1995). Nowadays education and training - so far confined merely to school years and venues – has to be considered as a lifelong learning, and as an unending training process. On the other hand, the ICT (Information and Communication Technology) innovation has contributed to the development of better educational and training support tools usable on Internet. In such way flexible and customized learning plan is possible in order to provide people with equal chances to access to and success in school, work activities and lifelong. As it is outlined in the Lisbon summit (Lisbon European Council, 2000) new learning/training tools can also offer the opportunities to adapt citizens to the rapidly changing patterns of living, learning and working environment.

E-learning is an important tool, without time-space constraints, to create a culture of education and lifelong learning for people of all ages and can offer European citizens the chance to acquire the necessary knowledge, skills, and competence.

E-learning can be considered both an effective and efficient channel for scientific literacy, and a lifesaver of professionalism. Moreover the European Conference: “Social and Human Capital in the Knowledge Society: Policy Implication” (Brussels Conference, 2002) pointed out the importance of having a national and European knowledge society strategy. In addition the Conference considers a strong and appropriate educational base, and lifelong learning institutions as basic foundations.

On 21 November 2001, the EU Commission adopted a Communication on Making an European Area of Lifelong Learning a Reality (http://europa.eu.int/comm/education/life/), where the education & learning area is divided in three forms: formal, non-formal and informal learning.
The work presented in this paper is an example of Dissemination Scientific Information and can be considered like non-formal learning: “the learning is not provided by an education or training institution and typically does not lead to certification. It is, however, structured (in terms of learning objectives, learning time or learning support). Non-formal learning is intentional from the learner’s perspective.”

In this paper we propose the e-learning course SIGEO as a dissemination scientific information action to promote a Geographical Information (GI) spreading as well as a more conscious Geographic Information Systems (GISs) use (Bargellini, M.L., Caiaffa, E., Casadei, G, Coletti , S., Puccia, L., 2004). SIGEO is an educational course about GI theory and GISs realisation techniques addressed to anyone who would start to be familiar with major basic concepts involved in the wide world of GI and would practise such technological tool as GIS. In particular SIGEO addresses decision makers, advisor institution for policy makers and stakeholders working for public administration (Salvemini, M., Toppen, F., 2001); in addition, it is addressed to create support and consultancy expertises to manage and resolve environmental and territorial problems (Caiaffa E., 2003). In general this course is advised as permanent educational tool for teachers, students and anyone would deeper own interest about GIS and its applications.

METHODOLOGY

E-learning environment

The ICT use inside educational/learning process leads to a revolution into educational scenario. Actors, roles and methods have to be re-think in order to be able to get, in the best way, opportunities offered by technological innovation (Rogers, C., 1969; Knowels, M., 1984; Trentin, G., 2001). The old scenario in which teacher and his/her knowledge are the hub of didactics, is changing in a new one in which learner plays an active role like protagonist. The learner builds his learning path in a customized plan, according to a personal learning action plan and following his own style and rhythm.

From informatics point of view it means to change from designer-centered approach to user-centered approach. From the technological point of view the future learning scenario will take advantage from emergent ICTs and, at the same time, will direct technological research efforts. In fact the educational /learning field already represents a large market share. From methodological point of view it is necessary to consider an e-learning product as a complex system in which its value is based on the integration among conceptual, technical and social models as contents, ICTs and services. This complex system is articulated in a methodological scenario in which the teacher knowledge, the user/learner requirements and the technological capability are involved. Educational/learning process becomes more and more flexible, independent, and permanent. Currently, all educational/learning phases should be integrated and projected into a ubiquitous learning environment, based on a horizontal approach in terms of methodologies, technologies, tools and services.

The KM2 methodology

Taking into account the new learning scenario, the ICT opportunities, and the scientific information dissemination demand, we have developed a methodology (Bargellini M.L., Casadei G., Coletti S., Puccia L., 2004) to design and implement e-learning courses towards Dissemination of Scientific Information. To design an e-learning course means to re-think how to offer the didactic resources. Moreover to allow students in building their learning paths it is necessary to consider didactic resources as a modular reality. Therefore during design phase it was necessary to define a course structure and to introduce some definitions. In our methodology we defined an e-learning course as a didactic path directly network accessible, with a precise cognitive target, well identified user’s requirements, learning results, and learning assessment.

An e-learning course is split into three levels:
- The Unit, identified as the elementary learning particle linkable to other units and reusable.
- The Lecture, defined as the knowledge atom characterized by an informative/formative objective and composed of several units.
• The Module, identified as lessons organic compound, it can exist stand-alone and can be reusable. The module has well defined content and learning objectives, and the learning level reached can should be evaluated. Moreover the units can be reused in more lessons in different modules.

In addition to didactic content modules, KM methodology schedule complementary modules, as glossary, terminology, video-training, photo-training, reference documentation, widening, related link, etc. (Bargellini M.L., Casadei G., Puccia L., 2003).

SIGEO COURSE PRESENTATION

SIGEO course is on ENEA website (www.odl.casaccia.enea.it) and it is accessible free of charge. The course looks to furnish fundamental technical and theoretical elements in order to enable the course’s user to: acquire a basic knowledge about GIS meaning; use GIS as a tool for territorial representation and planning; value the opportunity of a GIS design and construction; design a customized GIS having clearly in mind the final objectives; be able to read and to interpret GIS analysis. SIGEO students are not required particular preventive knowledge. The course addresses both those who are already employed and whoever wishes to amplify their own knowledge. The web-site has been designed with a friendly interface, so it does not require a specific skill in computer science. SIGEO course is described by a minimum data set, which represent the ENEA standard. The reference standard adopted consists of an introductive card describing the goals the intended audience, the pre-requisites, the contents, the estimated time for completion and other useful information (references, contacts, etc). The card is accompanied by a video-clip in which the teacher explains the contents of the course itself (figure 1). It is important to underline that the SIGEO realisation has involved: the teacher as responsible of formative contents and self-assessment texts; methodology and project group; technical support group.

Figure 1: video-clip in which teacher explains the course’s contents
It is possible to quantify human resources in SIGEO realisation involved as 2,5 years/man. Before its lunching SIGEO course was subjected to a usability test performed by six people with different cultural extraction and with different working experiences. SIGEO course is working since the 1st August 2004

SIGEO course contents are structured following KM² methodology (Bargellini M.L., Casadei G., Coletti S., Puccia L., 2004) which provides, among others things, the didactic contents’ subdivision in tree levels: Modules, Lectures, Units (figure 2). Units, just by their single argumentations and basic concepts nature, can be totally re-usable both in vertical mode and horizontal mode inside course’s structure (figure 2).

SIGEO structure

In addition to didactic modules (Bargellini, M.L., Caiaffa, E., Casadei, G, Coletti, S., Puccia, L., 2004), complementary modules are scheduled as studies in depth, terminology (glossary), self-assessment test, link for curiosity (figure 2). The on-line glossary allows users to read directly the terms that are considered basic for the content understanding. Touching on terms, that are in blue colour in the text, a window displays with the definition, without need to interrupt the lesson (figures 5,6,7).

Figure 2: SIGEO course structure

At the module level the KM² methodology schedules learning goals, key concept rucksack and self-assessment tests (figure 3). Learning goals represent fixed goals in didactic planning referring to specific module contents. Concepts rucksack are organized information atoms come out from module subjects splitting.

The self-assessment test is put in the course as an important methodological learning tool addressed to the learner. The self-assessment test not only assess the learning but especially help it. The student learns also, and above all, through his mistakes. During the self-assessment phase, while the learner is reading the teacher’s answer, he is more receptive and ready to acquire new knowledge: he is ready to understand how and why his answer isn’t right. We think self-correction process should be the best way to offer again a support in knowledge path. The feedback given by the self-assessment test works as a learning support (Hilgard, R., Bower, GB., 1986).

Learning goals, key concepts rucksack, and self-assessment help the learner to: steer himself during learning path; sum up learning path content; measure knowledge of a topic (figure 3). The self-assessment test is carried out through the proposal of some questions to learner. Some video clips containing pills of training movies in order to correct student’s errata answers are set up.
The SIGEO course is not limited only to describe GIS as an information tool, but it deals with GIS in a wide and complex scenario made of human competence and professional roles, hardware and software resources, GIS realization procedures, and so on. The course is moreover oriented to come out some concepts that are correlated to Geographic Information World, Geography and GIS, like spatial relations, representation scale, projection and reference systems, rather than a simple enumeration and description of GIS functions and operators because it is just the argument of any software GIS manual.

A furthermore new aspect of SIGEO course, which distinguishes it from the others, is the presence of two innovative learning modules: Studies in depth and Link for curiosity (figure 2). Studies in depth learning module makes able students to enter into a fine collection of articles GIS and GI involved as well as to get acquainted with scientific communications, technical notes, about themes linked with wide GIS and GI world. Link for curiosity learning module makes able students to acquainted with some events correlated to wide GI and Geography world as: exhibitions (www.societageografica.it),...
spreading seminars (http://www.rete.toscana.it/sett/territorio/carto/index.htm), days devoted to Geography celebration (http://www.gisday.com).

The studies in depth and curiosity modules presence enriches SIGEO didactic path. Such enrichment represents an additional value for SIGEO because KM² methodology permits insertion of auxiliary modules directly into the course. Auxiliary modules can have whatever format and content chosen by the teacher. Due to previous reason, SIGEO offers the possibility to navigate from one interest field to another with a simple click without quitting course.

Learning Modules

SIGEO was realised starting from a global knowledge of a GIS expert; knowledge to spread was selected having in mind different types of course’s users as well as prefixed learning goals. Such knowledge were modules organised, following the methodology dealt in the previous paragraph. The learning path starts from a wide range of GIS basic concepts definitions, data models used in order to represent GI on a map, to come to illustrate GIS design and realization. A particular attention is putted in the explication of some delicate concepts as geographic data/geographic information, territory representation, geographic data scale representation, geographic coordinates, projection systems, and unfamiliar concepts frequently causing confusion as well.

Inside Learning Modules

In order to report how we have treated the single arguments inside the different learning modules we have chosen to bring up for discussion some pages of course itself. The following pictures in the text show the style we have used to treat so different course’s topics. The first Module contains all those basic notions GIS technology involved, and some fundamental, conceptual, technical and applicative elements to perform a right design and an effective GIS use. For data viewing demonstration we use, for example, real GIS results (Ciaiaffa, E., 1999) showing different types of data representation:
thematic map representation (at desired map scale also), attribute table data representation, temporal
trend data representation in the case we have temporal data series (figure 4).

Figure 5: Principal projection reticula

GIS basic notions, contained into Module 2, make able user to understand what and how many are the
elements in a GIS: starting from GIS components, geographic data concept, information data concept,
spatial relationships, and so on, students arrive to the definition of geographic data representation
scale. A particular care is put in digital cartography description for which some historical references
to the ancient cartography and its evolution (Caiaffa, E., 2002) are given.

Geographic coordinates systems, projection and reference systems are treated in deep, in order
to clear the field by any misunderstanding about their meaning and importance in GI and GIS matters.
We spend a worthwhile effort to explain that one of greatest problem of a geographic map is to
represent terrestrial surface areas, absolutely not plane and not regular, in a plane geometry: a
geographic map must furnish the most realistic and effective representation of surrounding reality. In
particular Unit 4 Lesson 5 of the Module 2 drives students to consider that the earth effective surface,
we trample on or we sail, has not a regular shape and then the mass distribution in the terrestrial globe
results irregular. In order to correctly represent earth shape it is necessary assume an earth ideal shape
to satisfy mathematical and geometry rules. Starting from Latitude, Longitude concepts students
familiarise with projection systems. The projection method is a way to represent three-dimensional
spherical earth’s surface like a plane two-dimensional surface. Subjected to a such process, the real
earth’s surface will result deformed: it is necessary then to chose which characteristic we want
maintain nearest to the reality we have to represent: correct surface, correct angles, correct
distance…Every projection system will conserve one of this characteristics minimizing error on the
others (figure 5). Another example as we have treated arguments inside SIGEO course is shown in
figure 6: the datum is the ellipsoid reference emanation point that generally coincides with central
doem of the area we have to represent cartographically. We explain to ours students, through text and
pictures (figure 6), necessity to make fit ellipsoidal surface with reference geoids has produced
different ellipsoids and consequently different datum for different portion of terrestrial surface.

For this reason there are specific reference ellipsoids: every ellipsoid better fit its relative local zone
as for example, Europe datum, North America datum, and so on.

In order to make our course more complete the Module 3 contents treat a very important argument in
the field of Geographic Information Science: the data model inside a GIS. One of the fundamental
aspect of a GIS is just the data equipment necessary to its realisation: data provenience, rightness,
effectiveness, format, etc., are all aspects strongly conditioning the final results of the GIS in
construction. Spatial data representation inside a GIS is subjected to rules imposed by projection
systems. The effective data loadable in a GIS follow the two most important data models: vectorial
data (figure 7) and raster data. In Module 3 we deeply treat arguments related to data models GIS
inside and geographic data structure computer inside. The last but not the least of the treated
arguments is the data model object oriented.

GIS functions which are possible to accomplish on different data type, (we have previously treated),
and GIS operators performing them (facility that distinguish GIS from all others territorial
information systems types), are the Module 4 arguments. We describe GIS functions and GIS
operators using a qualitative style inducing students to familiarize with both possible functions in a
GIS, and tools to operate them on the data, avoiding to furnish simple function lists and functionality
descriptions, because these are any commercial GIS software manual arguments.

Finally a complete GIS course cannot ignore the great success the World Wide Web GIS applications
have obtained in the last year thanks more and more effectiveness WEB techniques. Even if to deal
Internet GIS should be necessary to set up a whole separated course, in Module 5 we give some
concepts and examples GIS on-line concern. We explain to ours students the mostly used architecture
client-server make us able to realise on-line applications exploiting server capacity memory.
CONCLUSIONS

SIGEO distance learning GIS course was ideated and implemented in order to fill a gap in GI and GIS dissemination often affected by too professional treatment or too basic notional treatment. The e-learning tool permits us to reach several kinds of students and users having different cultural level and extraction (Salvemini, M., 2004). For this reason was our strong intention to give the most complete and wide treatment of the several disciplines involved.

The most innovative aspects introduced in SIGEO can be individualised in the following topics: introduction of a methodology carried out from an innovative research in e-learning application field, setting-up self-assessment tests module by module, setting-up links to events’ and announcements’ collection. Such collection is correlated with GI and Geography world wide, and consists in exhibition, popular seminars, days devoted to Geography celebration, and so on. Moreover a glossary directly accessible on-line was set up. In SIGEO course, a special mention deserves self-assessment test system directly accessible inside the course. The self-assessment test is managed by an automatic system, that is able to give the right answer with the suitable correction in an automatic way. Corrections can assume different format: texts, images, audio, and videos.

On our intention SIGEO should furnish a power tool to induce the higher number of people to access GIS technologies and to familiarize with difficult concepts, often new, that are the basic principia of the Geographic Information Science, the importance of them is often underestimated by the specialists. To dwell upon such topics treatment and explanation is also in order to make SIGEO course a product useful for all people that could be potential GIS and GI users.

One of the future developments is to supply the SIGEO English version in order to meet the demand of all Countries that are recently entered in European Community as well as the Mediterranean area’s Countries that are now manifesting their interest about these technologies and matters.
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