KNOWLEDGE MANAGEMENT AND LIFE LONG EDUCATION IN SCIENCE

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ABSTRACT

In 1998 ENEA, the Italian National Agency for New Technologies, Energy and the Environment, launched an e-learning platform with the mission of sharing scientific knowledge among everyone, not just workers but also students and the unemployed, in order to use its research results to support competitiveness and sustainable development. In 6 years, more than 20.000 users have followed one or more of the 46 on line courses. Many agreements with schools, universities, private and public training organisation are now under way to improve the dissemination of scientific knowledge and to build an open data base of scientific learning objects that anyone can use.

Keywords: E-learning, Technological transfer, Research, Knowledge management, Life long education, SMEs

1 INTRODUCTION

Insufficient innovative activity is considered by the European Commission as a key factor behind Europe's underperformance in productivity growth (European Communities, 2002). Enhancing innovation is a cornerstone of the strategy to meet the Union's target agreed by the European council in Lisbon in March 2000 of becoming the most competitive and dynamic knowledge-based economy by the end of the decade (European Communities, 2003).

Enterprises are spurred on to innovate by pressures and challenges, notably competition and the desire to create new market places. While research is a major contributor to innovation, if there is no enterpreneurial action then there is no wealth creation. Nowadays in Italy, scientific knowledge belongs to Universities and research centres.

97% of The Italian production is undertaken by Small and Medium Enterprises (SME). SME workers are rarely involved in any training paths because they cannot leave the work place and because of their low educational level. To resolve these problems the ENEA has developed its e-learning Platform; firstly because the ENEA is an important source of scientific knowledge and thanks to the fact that new technological instruments typical of e-learning systems can be open to everybody, thus creating a new innovative culture in the country, secondly because we think that e-learning systems can be a good way to stimulate SME workers to learn outside of office hours. Our twenty thousand users prefer to study on our platform at any time of the day or week, Saturday and Sunday included.

The e-learning object model developed in ENEA has been designed by taking into consideration the heterogeneity of its users. The modularity of the courses and the possibility to achieve a university certificate at the end of the e-learning educational paths meets the requirements of our users.

2 THE ROLE OF LEARNING IN ECONOMIC DEVELOPMENT

The New Economy can be considered a Learning Economy in which learning is a strategic resource for the growth and economic development of industries and of countries (Gregensen, 2001). Innovation is fundamental to support the competitiveness of firms and to promote development. Hamel & Prahalad (1994) defined innovation as the renewal and enlargement of the range of products and services and the associated markets; the establishment of a new methods of production, supply and distribution; the introduction of changes in management, work organization, and the working condition and skills of the workforce. We believe that lifelong learning plays an important role in innovation, in fact the most innovative countries in Europe, as identified in the trend chart's innovation scoreboard, are also the leaders in lifelong learning according to the Best-Performance Index in the lifelong learning scoreboard (European Communities, 2002).

The importance of learning to the innovation process stems from the recognition that the knowledge frontier is moving forwards so rapidly in modern economies that simple access to knowledge assets merely affords a fleeting competitive advantage. It is the capacity to learn which is critical to the innovation process and essential for developing and maintaining a sustainable competitive advantage.

Schumpeter (1939) was the first to give importance to the active role played by economic agents in technical advances. In his theory the entrepreneur plays a central role. He considered the act of invention and the act of entrepreneurship as separate: the inventor need not necessarily be the entrepreneur and vice versa. However, the entrepreneur plays a central role since he is the one who turns the invention into an exploitable product. According to his "technology-push" theory, research leads to inventions, which then leads to the development, production, marketing, and introduction of innovations in to the market. Radically new inventions lead to the emergence of completely new industries and create economic development. The supply of new technologies is more important than adaptation to existing patterns of demand.

We believe that the Schumpeter technology-push theory must be revised, considering how important a factor learning is in promoting development. We envisage new virtuous cycle for the development and the growth of firms and of countries (Figure 1), in which the creation of scientific knowledge supports innovation thanks to training and learning processes.

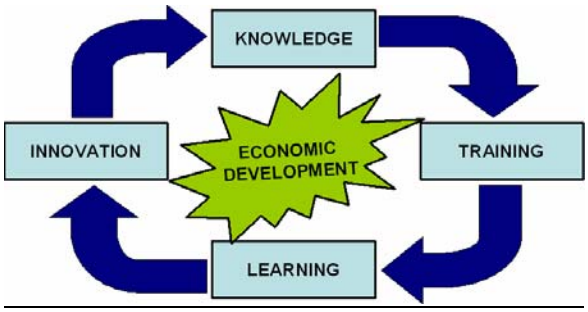


Figure 1. The virtuous cycle for development

The Italian system of education and training workers is a problem, relevant to the development of the countries economy. In fact in Italy, the number of people with technical degrees is one of the worst in Europe; in the Figure 2 (ISTAT, 2001) shows the actual picture of the educational level of the Italian workers. It is important to notice that only few workers have University degrees and only 6% of them have technical degrees. This make it very difficult to transfer technological and scientific advance and therefore promote the results of research among enterprises, especially SMEs.

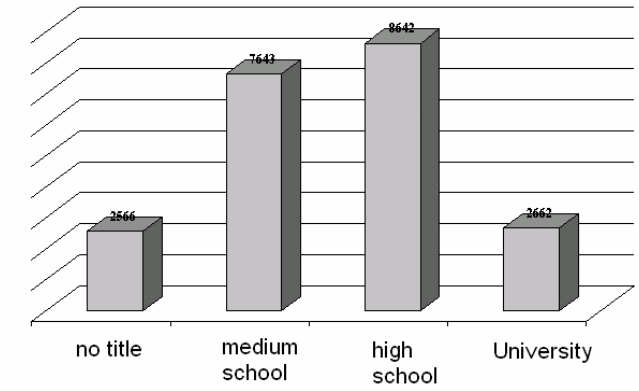


Figure 2. The educational level among the Italian workers

3 THE ENEA'S E-LEARNING PLATFORM

ENEA, the National Agency for New technology, Energy and Environment has started to develop an e-learning platform with courses in scientific subjects, in order to overcome the difficulty of technology transfer,.

Our experience started with an pilot project with 250 workers in four Italian regions. In the last 6 years more than 20,000 users have followed one or more of the 43 free on line courses.

The first group of courses was related to quality, energy and safety matters, now the courses offered cover more specific subjects such as photovoltaic energy, biotechnology, e-commerce for textile industries, and so on. The interface is very user friendly and has been developed in the ENEA Usability Laboratory.
The Figure 3 shows the home page of ENEA's e-learning platform (ENEA E-Learn, 1996).

Figure 3. Home page

The ENEA e-learning platform's architecture based on Active Web Matrix is shown in Figure 4 (Fontana, 2003).

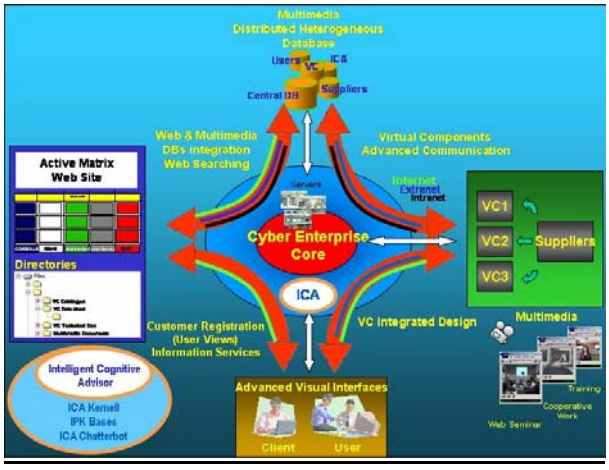


Figure 4. The ENEA e-learning platform's architecture

The ENEA e-learning platform offers the following services:

- a guest book to allow guests to leave messages related to the services;
- the contact address;
- browser tests that enable the users to set up all the tools needs for a good view of the courses;
- statistical data about the users themselves, collected from the results of the customer satisfaction questionnaires;
- glossary, divided into subjects, to explain the meaning of the different terms used in different fields;
- it's possible download a series of documents related to the course subjects or to e-learning and ICT (information and Communication Technology) in general;
- user manual to explain how to use the training material and services;
- customer satisfaction questionnaire for every users that reaches the end of a course;
- auto-evaluation tests for the courses;
- WEB DB, that is data-base based on the web; this WEB DB provides the opportunity to have a short description related to a particular subject: a church, a plant, etc.
- FAQ (Frequently Asked Question) section to answer commonly asked questions.

We have compiled statistics about our users profiles through the customer satisfaction questionnaires.

The gender distribution of users shows that the most common users are males (Figure 5) but the proportion of women users is an important indicator of the poor presence of the women in Italian education and training.

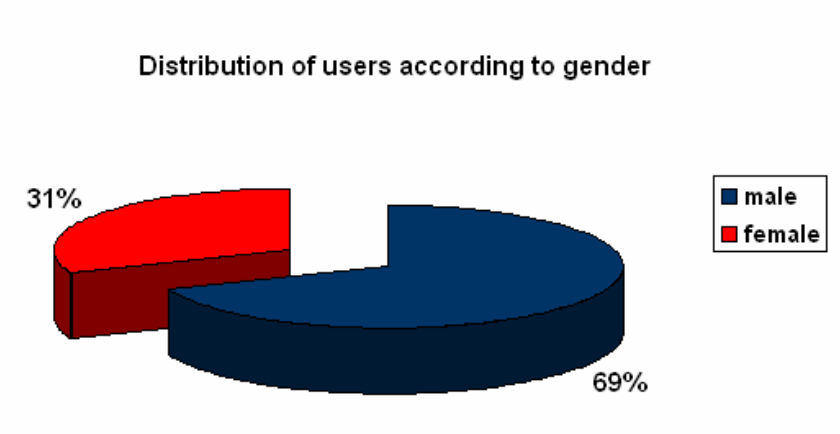


Figure 5. Distribution of the users according to gender

The most significant number of our users (59,7%) are public and private managers and employees (Figure 6). The age range of our users is between 20 and 70 years old, and 69% of them are between 26 and 40 years old. ENEA platform users accessed the web site to study at all hours of the day and on every day of the week, Saturday and Sunday included.

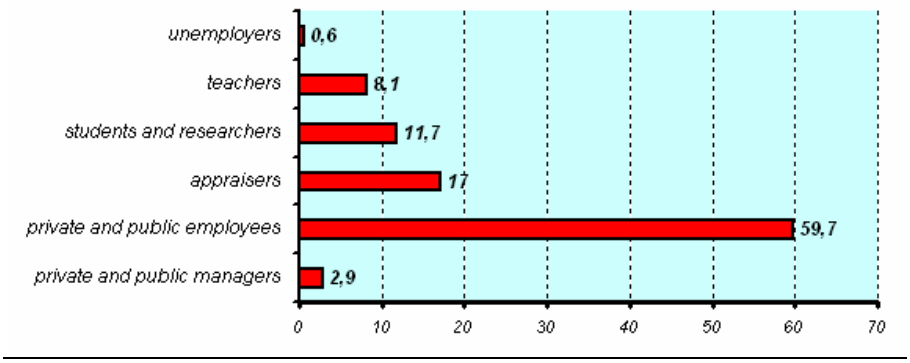


Figure 6. Distribution rates of categories of users

4 THE MODULAR APPROACH FOR COURSES

A number of studies (ASTD, 2001) have shown the advantage of e-learning in being able to provide flexible, 'just-in-time' learning with smaller learning 'components' than traditional course structures. This has fuelled the movement towards modular or unit based learning and the development of learning objects. Learning objects are based on the idea of an open standard supporting the creation of small 'components' of learning. The key benefits of object-based e-learning materials are seen as follows:

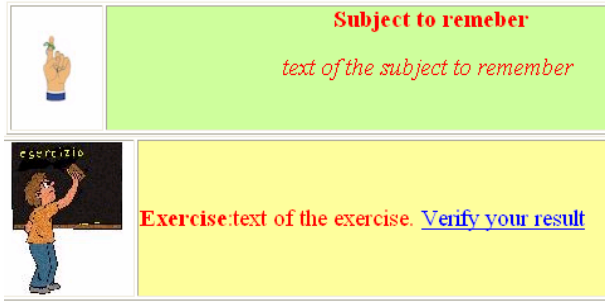
- Content in the learning objects format can be more readily reused for different purposes and can be easily updated by replacing only the outdated content rather than having to rebuild a new course;
- Customised learning can be produced to meet specific individual needs;
- Learners are able to locate the particular information they need from learning objects according to the context of their work.

The heterogeneity of Italian workers in terms of educational background, type of industrial field and/or business and geographic location together with the large number of potential users, has made it necessary to develop a special format that would be suitable for as many users as possible, so that automatic processing is possible. This is the modular approach based on learning objects; a learning object is considered to be any reproducible and addressable digital or non-digital resource used to perform learning activities or support activities (IMS Global Learning Consortium, 2003). It means that the subject is decomposed into its essential parts and each of these starts from very basic concepts going, into more detail in successive modules. This learning system is able to allow personalization within a learning design, so that the content and activities within a unit of learning can be adapted based on the preferences, portfolio, previous knowledge, educational needs, and situational circumstances of users. The courses prepared in this way are suitable for any worker at any educational level. This modular approach, by itself would not solve the problems of people with more expertise who would be bored if they had to start at the beginning. A self evaluation test has been introduced between successive modules, in this way any user can first take test to evaluate his knowledge of the subject and then decide for himself whether to study the course from beginning or to skip the simpler earlier modules.

To help navigation the course's index can be visualised along with the lessons (Figure 7).

Figure 7. The modular approach to long distance learning developed by ENEA in the CASCADE project (CASCADE, 2000)

In the header of the lesson a number indicates how many lessons there are for each module. The length of each lesson has been optimised in such a way that it can be studied, not just read, in about 20 minutes, as this is the optimal period that a person can pay attention without stress.



For the same reason all the texts have been structured in the same fashion, so that the users will find themselves in the same environment in spite of the different subjects, taken Iconic language helps the user to easily notice things to remember, the examples, the exercises, etc. as shown in the Figure 8.

Figure 8. Iconic language to reduce the stress of distance learning

5 CONCLUSION

The ENEA's learning architecture has followed the IEEE P1484 Learning Technology Systems Architecture (IEEE Learning Standards Committee, 2005) shown in the Figure 9.

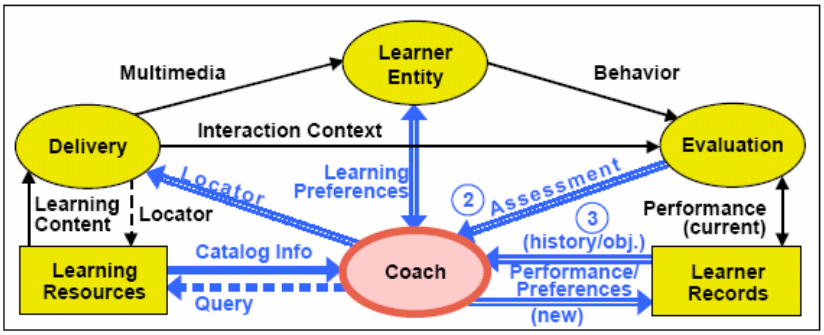


Figure 9. The IEEE P1484 Learning Technology Systems Architecture

In the above model we can identify the following roles:

- the learning entity is the worker;
- the evaluation system is represented by an automatic self-evaluation system;
- the learning resources are the learning objects produced by ENEA;
- the delivery is presented using the ENEA's e-learning platform;
- the coach can be considered a mixture of different roles taken up by different people such as the authors of the learning objects, those responsible for the training inside on enterprise, or a third party that is in charge of promoting training inside the enterprise;
- the accreditation and the learner records could be represented by a third body that is able to certify the skills of the workers through tests and by monitoring the progress of the worker in a specific field, as happens in some professions such as welding inspectors.

Similar work is evolving in the USA developed by the Massachusetts Institute of Technology (MIT). Two thousand free on-line courses are going to put on line by the MIT by the end of next decade (MITOpencourseware, 2005).

We think that knowledge is the public resource of everybody and that the diffusion of scientific knowledge to as many people as possible is more important than earning money. At the moment our on-line courses are only in Italian but we are translating them into English as well.

Our on-line courses have been helpful to many users for finding new jobs, or for improving their professional position, as the emails that we receive from our users show. We are building a network of national and international collaborations, with public and private stakeholders, to improve the quality of our courses and services.

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