AN ANALYSIS OF THE DIFFUSION OF INFORMATION TECHNOLOGY IN EDUCATION

Towards Europe's Information Society

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Abstract: The accelerated development of the information and communication technologies determined educational institutions and companies to implement alternatives to the traditional teaching methods. The new literacy determines the e-learning competencies. The paper concerns an analysis concerning the expenditure for information technologies, the use of computer and of Internet, computer and Internet skills, and also e-learning in the EU countries. The results showed that there are disparities among EU member states regarding the extent and the perspectives for the developing of e-learning.

1 INTRODUCTION

In the last decade, the tremendous increase in the amount of available information was possible through the enhancement of the access to computers and to Internet. The information era make possible the enlargement of the information' accessibility by tools more sophisticated. Education is facing many challenges to become more relevant for the information society. In this society the citizens have to be life-long learners, the workers are expected to acquire independently knowledge and skills and to be able to communicate in a variety of contexts. This requires an important transformation of education and ICT can be the means to realize this transformation (Fredriksson, Jedeskog, Plomp, 2007).

Thus, one of the goals of the educational system should be to prepare students for taking an independent and responsible role in the information society. Furthermore, this goal will be achieved only if the students acquire the necessary skills for working with large amounts of information from a wide range of sources (Barzilai, Zohar, 2007; Land, Greene, 2000; Salomon, 2000). ICT mediated learning became an integral component of education and training systems. Moreover, with the rise of ICT era, new competencies became vital. Digital literacy, the ability to use ICT, is one of the most important.

E-learning has emerged as an imperative tool to deliver knowledge in the academic as well as corporate sectors. Backed by several favourable trends, the world e-learning market is projected to exceed US$52.6 billion by 2010 (http://www.strategyr.com/pressMCP-4107.asp). The US retains its dominance in the corporate e-learning market with a share of over 60%. Europe is the second largest market with a share of less than 15%.

Despite its obvious advantages in terms of reduced costs, simplified training programs and flexibility, the e-learning is not always the miracle solution. Conceived as a powerful educational tool, e-learning was destined to change the face of learning. But unfortunately this change wasn't exactly the one it was intended. In Europe, corporations face the problem of poor utilization of the eLearning solution and the corporate e-learning has real problems in all stages as follows:

a. Initial Design Issues (lack of identification of real needs; poor strategic design decisions regarding: the structure of the course, methods and media to be used, course management and evaluation).

b. Instructional Design and Development Issues (lack of detailed instructional design; failure to develop instructional design elements-authoring or graphic design; lack of evaluation and revision of the instructional design).

c. Dissemination and Implementation Issues (problems in production, reproduction and distribution; poor implementation and use of the e-

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learning; long term management and evaluation). (Romiszowski, 2004).

If we take into account these problems we can state that a lot of corporate e-learning initiatives are failures; we mean that *the intended learning did not really take place*. Technologies such as Learning Management Systems (LMS) and Learning Content Management Systems (LCMS) are widely spread but these do not lead to the intended learning. All the technologies *without effective online instruction* will not produce any significant learning results. There are some explanations for these (Woodill, 2004): (i) the rush to launch on the market the new educational courseware and educational technology without a proper testing; (ii) focus on new technology, not on instructional design; (iii) lack of understanding of learning and teaching and of the unique teaching advantages of electronic media.

In these circumstances there are lessons to be learned by the software providers. Both, the technology-obsessed course developers who create highly interactive, very spectacular and very expensive multimedia courseware that are not very efficient and the courseware creators that offers numerous simple programs, a kind of page-turners that are little more than PowerPoint presentations, need to take into account solid quality standards for e-learning and need to be based on sound educational principles.

2 DATA AND METHOD

The information society can be characterized by certain indicators, among which we used 15 variables regarding computer and Internet, clustered in 5 groups as follows:

a. Information Technology Expenditure, which contains Information Technology Expenditure as a percentage of GDP (*inf_techn_inGDP*) and GDP per capita, EU27=100 (*GDP_capita*)

b. Level of Internet access and Internet and computer use with: percentage of individuals who used a computer within the last year (*i_clt12*); Percentage of households having access to the Internet at home) (*h_iacc*); Percentage of individuals regularly using the Internet (who accessed Internet, on average, at least once a week) (*i_iuse*)

c. Individuals' level of computer skills: Percentage of individuals who have carried out 1 or 2 of the computer related activities (*i_csk_lo*); Percentage of individuals who have carried out 3 or 4 of the computer related activities (*i_csk_me*); Percentage of individuals who have carried out 5 or 6 of the computer related activities (*i_csk_hi*)

d. Individuals' level of Internet skills: Percentage of individuals who have carried out 1 or 2 of the Internet related activities (*i_isk_lo*); Percentage of individuals who have carried out 3 or 4 of the Internet related activities (*i_isk_me*); Percentage of individuals who have carried out 5 or 6 of the Internet related activities (*i_isk_hi*)

e. Indicators regarding e-learning: Percentage of individuals who used Internet, in the last 3 months, for formalized educational activities (school, university, etc) (*i_iedu*); Percentage of individuals who used Internet, in the last 3 months, for other educational courses related specifically to employment opportunities (*i_ieduot*); Percentage of individuals who used Internet, in the last 3 months, for post educational courses (*i_iedupt*); Percentage of enterprises using e-learning applications for training and education of employees (*e_iedu*)

Data values are registered at country level for the 27 EU member states, the reference year being 2006. We used data from Eurostat and also from E-communications Household Survey carried out in November-December 2007. The interviews were conducted among over 26000 EU citizens in the 27 Member States of the European Union. Among the topics addressed was one named Computers and Internet.

In order to explore the data set and to identify and characterize the EU countries e-learning characteristics as well as the existent resources for developing of e-learning, we used principal components analysis (PCA). The value of Barlett's test of sphericity and the value of the indicator MSA of KMO indicate that the considered variables are adequate for a PCA. We also performed a cluster analysis in order to identify the groups of homogenous countries concerning certain ICT indicators.

3 RESULTS

The results obtained from the analysis of the E-communications Household Survey revealed that 57% of European households have at least one computer. There is a significant difference in household computer ownership between the European Union's old and new member states. The lowest computer penetration rates are found in the European Union's newest Member States: Romania – 35% and Bulgaria – 27%. Regarding the Internet access, we notice that 49% of households within EU

27 have Internet access (Special Eurobarometer 293). In 25 % of countries, the Internet penetration rate is below 35%. The highest rates were registered in the Netherlands, Denmark and Sweden, and less than 25 % of households in Romania, Bulgaria and Greece had Internet access. If we correlate these two indicators, the computer rate and Internet rate, we can say that the lack of a computer is an obstacle to Internet access.

Factorial solution indicates variables' grouping in 4 principal components which have an explicative power of 82.696% of the total variance. As the variance the first two factorial axis account for is 64.799% of the total variance, we will analyze below the characteristics of e-learning and e-learning resources in EU countries according to the positions of variables and of cases in the factorial plane determined by this first two component.

It can be noticed that good economical results create a basis for supporting the development of e-learning, while the investments in information technology are directly correlated with population access to Internet and with individuals' computer skills and Internet skills.

We can identify some characteristics of e-learning in EU countries (Figure 1). Thus, it can be noticed that countries that were integrated in the latest wave (Romania and Bulgaria) lay on the left side of the plane, being characterized through lack of or low resources for e-learning development: low access to Internet, reduced investments in information technology and small percentages of individuals with computer skills and Internet skills. Greece, Italy and Ireland have similar characteristics to these two groups of countries, while Slovenia and Estonia are exceptions as the profiles of their e-learning are closed to that of the most developed EU states, although Estonia is the EU country with the lowest interest in e-learning activities. The old EU countries are characterized by significant resources for e-learning development supported by good economical results and important investments in information technology and show a relatively high interest in using Internet for educational purposes.

It can be seen that the e-learning is not very developed in Spain and Portugal, the two countries finding themselves in the quarter of the factorial plane which express the lowest interest in e-learning activities and the poorest basis for e-learning development. Romania is also positioned in this area of the factorial plane having e-learning characteristics similar to Greece and Bulgaria. It owns the poorest resources for e-learning development as it presents the smallest score on the first factorial axis. Individuals' and enterprises' interest in e-learning activities is still a reduced one comparing with the other EU members.

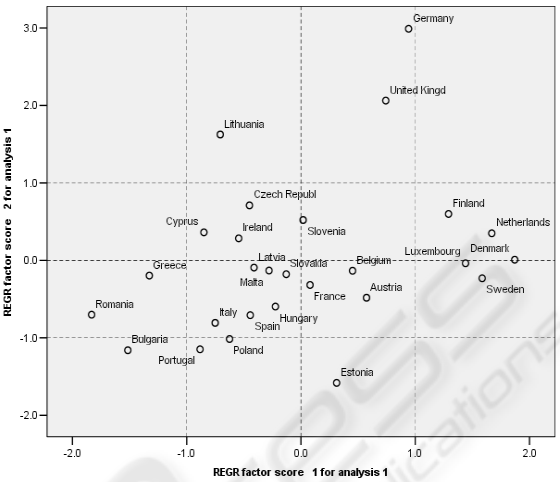

Figure 1: Countries' position on the first two factorial axes.

Analysis of countries' positions on the factorial map allows us to identify the countries where the e-learning has the greatest extent or the most favourable environment for its development or those that present the lowest interest in or the lesser developed basis for e-learning activities, using the rule of the 3σ on each factorial axis (Jaba 2007). The axis of peoples' and enterprises' interest in e-learning activities identifies Germany over the limit $\bar{x}+3\sigma$, as having the highest percentages of individuals and companies that are using Internet for educational purposes. This country is followed by UK and Lithuania near the limit of $\bar{x}+2\sigma$ interval, all the three countries being positioned at a significant distance from the other EU members according to the second axis. The lowest interest in educational services via Internet is met in Estonia, Bulgaria, Portugal and Poland, which exceed the limit $\bar{x}-\sigma$ on the first axis. According to the first axis, the most important resources, expressed in the level of internet access, individuals' computer and Internet skills and economical support, are specific to Denmark, Netherlands, Sweden, Luxembourg and Finland, which are situated at the right side of $\bar{x}\pm\sigma$ interval. They are followed by Germany and UK, at the limit of interval. An explanation of this pattern of diffusion is that in the education and training systems in these countries the English language is dominant. At the opposite side we find Romania, Bulgaria and Greece, at the left side of $\bar{x}\pm\sigma$ interval, where the poor resources limit the

perspectives for the development of e-learning. In these countries people and enterprises confront themselves in a greater extent with the lack of Internet access or adequate skills together with a poor economic support for developing educational activities using Internet.

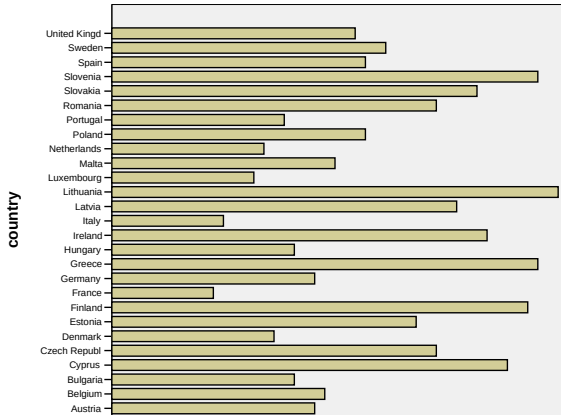

Figure 2: Percentage of enterprises using e-learning applications for training and education of employees, by country, in 2006.

Concerning corporate eLearning, the data from Eurostat revealed that the highest percentages of enterprises using e-learning applications for training and education of employees are registered in Lithuania, Slovenia, and Greece (Figure 2). This can be explained by the size, the number and the profile of the companies using e-learning tools for employees training.

If we group the countries by the indicators regarding Information Technology expenditure, Internet access, and computer use one can notice 5 groups as follows: 1. Italy, Portugal, Czech Republic, Poland, Lithuania; 2. Spain, Hungary, Ireland, Slovenia, Latvia, Slovakia; 3. Bulgaria, Romania, Greece; 4. Denmark, Sweden, Netherlands, Finland; 5. Germany, United Kingdom, Belgium, Austria, Estonia. The highest percentages (averages) concerning the above indicators are registered in group 4 and the lowest, in group 2.

4 CONCLUSIONS

Despite the similarities among the countries from each cluster concerning the indicators on Information Technology expenditure, Internet access, and computer use, there are significant differences among the 5 groups of countries. The explanations are different from country to country.

E-learning was seen having a tremendous potential to respond to the challenges of the knowledge society, to improve the quality of learning, to address special needs, and to bring about more effective and efficient learning and training at the workplace (Ruttenbur et al. 2000). But the reality is pretty different from what, not long time ago, the enthusiasts foreseen. E-learning, in generally and corporate e-learning, in particularly, does not represent the revolution within corporate training (Cross, 2007) and the direction of e-learning's evolution does not prove to be the appropriate one.

In these circumstances, the differences among European countries regarding the use of corporate e-learning may turn out into an advantage for the group of "ITC underdeveloped". Bridging the ITC gap does not mean for these countries to embrace in a non-critical manner e-learning strategies and tools. Starting from the positive and negative experiences within this field, following the instructional design principles, general e-learning strategies and corporate training must be reconsidered within the new global realities.

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