

## MONOGRAPH

# “The Economics of E-learning”

*David Castillo-Merino (coordinator)*

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## Monograph “The Economics of E-learning”

## INTRODUCTION

# A Theoretical Framework for the Economics of E-learning

David Castillo-Merino  
Mikael Sjöberg

Submitted: February 2008

Accepted: February 2008

Published: April 2008

## Abstract

The economics of e-learning was identified as a key priority for virtual campuses in the consultation workshop held in Brussels on 23 November 2004. The eLene-EE (Economics of E-learning) project has aimed to increase knowledge on the incentives to create virtual campuses and initiate teaching methods for education based on ICT and its effects, ensuring that this is efficiently carried out while reflecting the various situations at the partner universities. This RUSC special issue on the economics of e-learning shows the theoretical framework we have defined and some of the results we have obtained within the eLene-EE project, funded by the European Commission.

Our findings have clear policy implications and will help e-learning designers, learners, financiers, and decision makers to build up, adapt, and improve their initiatives. The project is divided into five integrated research and development work packages (WP) with participants from universities in the eLene consortium (from Sweden, France, Spain, Italy and Poland).<sup>1</sup>

## Keywords

e-learning, economics of education, knowledge economy, universities, productivity

## *Un marco teórico para la economía del e-learning*

### *Resumen*

*La economía del e-learning se identificó como una prioridad clave en el taller de asesoría de campus virtuales celebrado en Bruselas el 23 de noviembre de 2004. Con esta idea, el proyecto eLene-EE (Economía del e-learning) ha tratado de ampliar el conocimiento relativo a los incentivos para crear campus virtuales e iniciar métodos de enseñanza en la educación basada en las TIC y sus efectos, asegurando que esto se lleve a cabo eficazmente mientras refleja las diferentes situaciones de las universidades asociadas. Este número especial de RUSC sobre la economía del e-learning muestra el marco teórico que hemos definido y algunos de los resultados que hemos obtenido en el proyecto eLene-EE, que ha sido financiado por la Comisión Europea.*

1. For further information on eLene-EE, please visit our site: <http://www.elene-ee.net>

*Nuestros resultados tienen unas implicaciones políticas claras y ayudarán a los diseñadores, estudiantes, financieros y gestores de e-learning a crear, adaptar y mejorar sus iniciativas. El proyecto se divide en cinco paquetes de trabajo de investigación y desarrollo (WP) integrados por participantes de universidades del consorcio eLene (universidades de Suecia, Francia, España, Italia y Polonia).*

### **Palabras clave**

*e-learning, economía de la educación, economía del conocimiento, universidades, productividad*

## **Introduction**

From an economic perspective, economic and business activities are characterised by profound changes that modify the behaviour of all economic agents. These changing trends explain an economic change that can be framed within a wide context: the emergence of the knowledge-based economy. The development of this new scenario in developed economies is characterised by rapid knowledge creation and easy access to knowledge, conditions that generate greater efficiency, quality and equity (Foray, 2004). The Evidence for the advent of a knowledge-based economy is seen in the increase and improvement of knowledge-intensive activities throughout all industries of the economy more than in the continuous expansion of a specialized productive sector (Eliasson, 1990). The key differences in economic dynamics from the economies of earlier periods can be identified in the quality improvement of the production factors through a process based on the creation of new knowledge and ideas and their incorporation in physical and human capital.

In general terms, this transformation process is based on a technological revolution – the digitalisation process. It is built upon a dynamics of spatial and temporal market expansion – globalisation and it feeds back according to the changes of the patterns of demand of families and companies. This process has a clear through-line: the intangible value of the economic activity that, in other words, is the progressive consolidation of a new knowledge-based economy (Vilaseca and Torrent, 2004).

ICT is not the only causal factor in the global knowledge economy,<sup>2</sup> but it is clear that with ICT the knowledge-based economy has found a suitable technological base because there has been a clear interrelation between the upsurge of knowledge-intensive activities and the production and diffusion of ICT. Digital technologies are now consolidated as one of the necessary instruments to develop

network activities and increase knowledge in the economic sphere. The complex interaction between the emergence of digital technologies and their production is profoundly transforming economic activities. ICT has become a key component of this economic transformation, with the rise of a new production sector that extends its synergetic effects not only to other branches of activity, but also to all other economic activities. This social background of knowledge has impregnated the economic activity to such a point that, currently, we can quote a growing number of interdisciplinary studies that sustain the following hypothesis: ICT is the technical paradigm on which the current dynamics of the industrial revolution is based.

A consensus has emerged that the diffusion and the productive use of ICT (through its effects on knowledge creation and transfer across industries) can be situated at the material basis of the economic growth of many developed countries since 1995 (Nordhaus, 2002; Jorgenson, Ho and Stiroh, 2005). The main driving forces behind this are a combination of the speed of technological change and product improvement in semiconductors and the continuing fall in their prices. Falling IT prices have provided important economic incentives for the effective diffusion of digital technologies among the different industries in the economy. This rate of price decline is a key component of capital costs, and it can be explained by the impact of rapidly growing stocks of computers, communication equipment and software.

Within this analysis of the sources of productivity growth in the paradigmatic model of the USA, we can come to three main conclusions: first, in terms of output, gross output growth, as well as intermediate input growth and value-added growth can be explained by a set of relatively small industries that produce information and communication technology (computers and office equipment, electronic components, communication equipment and computer services) and service industries. Second, in terms of capital services, the majority of US industries have re-

2. Authors such as ABRAMOVITZ and DAVID (1996) demonstrate that technological discontinuity can be dated well after the switch of developed economies towards knowledge-intensive activities.

sponded to declines in relative prices of capital (a direct externality from ICT-producing industries) and have shifted their investment patterns to ICT assets, a fact that is showed by the faster growth in ICT assets than in non-ICT assets, and by the growing share of ICT capital in total capital services; the rapid acceleration of ICT capital services is a widespread phenomenon that has benefitted almost every industry, especially those within the ICT-using sector. And third, in terms of labour, the productivity growth after 1995 has been accompanied by major changes in the allocation and composition of the work force, since the positive trend in labour quality during the period 1995-2000 is explained by the rise in average levels of educational attainment, as older and less-qualified workers retired and left the labour force and, complementarily, young workers improved their education attainment.

The age profile of workers has also changed, with young workers receiving premium rates closer today to the more experienced workers than in the past. This empirical finding is consistent with the hypothesis of a skill-biased technical change and the existence of complementarities between ICT inputs and young workers. Therefore, these results show the effects of the ICT revolution on labour markets, particularly the fact that college-educated workers were the main source of employment growth throughout the period 1977-2000, although the evolution was more varied in the interval 1995-2000, due to a stabilization of the education attainment levels and a high economic growth drawing in workers with lower cognitive skills. There is a link between productive uses of digital technologies and labour composition; in particular ICT-producing and ICT-using industries show an increasing demand for ICT skills, which has been associated an expansion of the education industry.

Another important conclusion is the considerable variation in labour productivity growth, in TFP growth, in the quality of labour and employment growth, and in capital services gains, across industries and across time. This fact indicates the important differences between industries in terms of production processes, input demand and allocation, and growth prospects, strengthening the hypothesis of the existence of complementarities between technical and organisational change and skilled labour input to explain productivity gains at the industry level. Nevertheless, it is remarkable that ICT-producing and the majority of ICT-using industries have experienced a substantial growth in these indicators since 1995.

It should be pointed out that the diffusion of a new technology is a long and complex process of building complementarities at many levels, within the concepts of tech-

nological and organisational trajectories and progressive adjustment of economic and social capacities to a technological revolution (Freeman and Soete, 1997). The full realization of the potential of ICT (as a general purpose technology) is a long process that is contingent on significant technical, organisational and institutional adjustments (Foray, 2004). It must also be taken into account that ICT requires new industrial and innovative organisations built around a network and strongly based on digital technologies uses, and that the high degree of innovation in digital technologies leads to the need for continuous adaptation to a perpetual and radical technological change that underlies the economic base of productivity gains. In other words, an organisational culture of change is needed at the company level to deal with the constant upgrading of software and hardware that leads to constraints of interconnectivity and interoperability for the user.

The way to address the issue of ICT complementarities has emerged as a focus of analysis in the industrial organisation literature, within the framework of the investment theory. From this perspective, the two main adjustment categories in the process to exploit the potential benefits of ICT usage at the company level are concentrated in the organisation of the production processes and the demand for specific skills and abilities.

Concerning the first category, we adopt the thesis that the main driver of organisational change in firms is the need to adapt to changing competitive conditions. In this field, there is a mutually beneficial relationship between organisational change and ICT investments. Digital technology is a key element to facilitate new organisational practices, such as lean production, team-working, more decentralization in strategic decision making activities, and a closer interaction with customers and providers of intermediate inputs (Bresnahan *et al.*, 2002; Cristini *et al.*, 2001). Therefore, ICT availability and usage increase firms' capacity to adapt their organisational structure to these new network requirements. At the same time, efficient ICT use by firms requires some specific organisational changes in order to maximize the exploitation of their technological capabilities. How ICT and organisational change are combined within a firm will determine the efficiency level achieved and, therefore, the degree of productivity gains. Company-level organisational change can take many forms, but they can generally be classified into three broad systems (Murphy, 2002): 1) The restructuring of production processes (including Total Quality Management practices, lean production systems, Just-In-Time methods and business re-engineering processes); 2) Management systems and employee involvement schemes (with practices such as

decision-taking decentralization, teamwork, knowledge management, flexible work arrangements and flexible compensation); and 3) External re-organisation that emphasises customer orientation, outsourcing and company networking.

There is also an important relationship between development and diffusion of digital technologies and demand for specific skills and abilities devoted both to the production industries of technological innovation and to labour input of the broad economy. These skills can be separated into two main classes: 1) cognitive (or technical) skills related to ICT production and use, especially those needed for the correct use of digital technologies that allow individuals to surpass the constraints derived from the continuous and accelerated upgrading of digital innovations; and 2) non-cognitive skills (or “soft-skills”) or abilities that are not directly related to the production requirements but also necessary because they enhance individual development and social participation (Levin, 1998). The latter includes entrepreneurship, adaptation to changes, cooperation, teamwork, knowledge transmission, problem solving, decision making, information management, self-programming, learning abilities (especially bias to continuous learning or “long-life learning”) and communication skills; these abilities are not new, but they are crucial to fit the new technical change requirements and to keep up with the constant change in economic activities.

There is a large amount of empirical evidence that demonstrates the beneficial effects in terms of company productivity of these complementary relations between the two above mentioned innovations, ICT adoption and organisational change, and the demand for skilled workers. The main conclusion from this work is that company performance improves when digital use is accompanied and co-integrated with a re-organisation of business processes and labour management, and the participation of more qualified workers.

In summary, education has a critical role in sustaining economic and productivity growth based on ICT investment and usage, not only for its direct allocation to the innovation processes of those industries responsible for knowledge creation, but also for its importance in efficient use of digital technologies by workers across industries in the economy and the improvement of the individual’s capacities for knowledge management, transfer and productive usage. Therefore, organisations on the supply side of the education industry, where universities are included and have an important role, have significant challenges along two main lines: 1) to generalise access to education across the population and encourage the im-

provement of educational attainment levels, to respond to the social demand of a life-long learning offer, and to fit with workers’ needs for specific skills and abilities, and 2) to adapt their organisational and institutional structure to the innovation process for effective and efficient ICT use in teaching and management activities through the adoption of new business models, and to achieve an intensive use of digital technologies in the teaching and learning processes (courses and programs) in order for students to attain the ICT skills and abilities required in the labour market by teaching them how to use and, what is more important, how to apply digital technologies to their professional activities.

In this field, e-learning is an opportunity to encourage a general ICT policy in universities that can favour their organisational adaptation to digital requirements in terms of better performance, and to offer students a continuing education that may lead to the development of skills better linked with the production needs of the knowledge economy.

## Positive externalities of e-learning

Education must be considered as a key investment in modern economies because, as we have shown, within the framework of a knowledge-based economy there are strong and positive complementarities between economic activity and education in the explanation of economic growth. E-learning can contribute to the beneficial dynamics by increasing access to education in society as a whole, avoiding traditional constraints related to space, time and pace of teaching and learning systems, and allowing education access to many people who would otherwise not enrol on courses.

We can affirm that education leads to important benefits, both for individuals and for society as a whole. In economic terms, human capital accumulated as a result of the educational process should be considered as a mixed good, i.e. a private good with public externalities. The nature of education goods leads to the distinction between private and social educational benefits.

From the point of view of the individual, and following the human capital theory approach, the increase in an individual’s level of educational attainment is consistent with an increase in their productivity in the labour market, which is the reason for higher wages for more educated workers. Since the time of Mincer (1974), who estimated that around 10% of wage increases in the USA was attributable to an individual’s schooling, a huge amount of empirical evidence<sup>3</sup> has demonstrated a high positive correlation be-

tween individuals' educational levels and wages. Therefore, taking into account age and experience, better-educated workers earn more than their less-educated peers (Cipollone, 1995). However, education is not the only explanatory variable of wage differentials. There are other variables, sometimes difficult to measure, affecting labour market outcomes: individuals' innate ability, social and economic status, family background or other social factors. But, as pointed out by Hinchliffe (1995), earnings functions and path analysis of the effects of individuals' background characteristics on occupational attainment and earnings have indicated that, while much of the variance remains unexplained, the largest single indicator is education. Indeed, it has also been proven that a virtuous circle arises within the complementary relations between education and income, so that education can explain higher earnings for workers while higher income causes increases in the demand for education (Sianesi and Van Reenen, 2002).

Other benefits from higher levels of education, directly related and complementary to wages, are 1) the increased likelihood of participating in the labour market and 2) the decreased probability of being unemployed. Participation in the labour market and unemployment rates are closely related to education (OECD, 1997 and 1998; De la Fuente, 2003), and help to explain the economic benefits for individuals.

An important concern is that the benefits of educational investments for individuals extend beyond increases in earnings and employment conditions to other factors that have an indirect effect on economic benefits. Education has a positive impact, among others factors, on health (Taubman and Rosen, 1982; Desai, 1987), on intergenerational cognitive development (Angrist and Lavy, 1996; Lam and Dureya, 1999), on developing more rational organizational and financial competence, and better analytical skills (Lassibille and Navarro Gómez, 2004), on a greater likelihood of participating in politics and social decision mechanisms (Campbell *et al.*, 1976), on adopting a better consumption technology and a greater efficiency in making consumer choices (Rizzo and Zeckhauser, 1992) and on higher rates of saving (Solomon, 1975). All these additional advantages are real benefits from education but they are difficult to measure in monetary terms.

From a social point of view, education plays an important role in determining the level and the distribution of

income, in company (and institutions in general) productivity and in economic growth.

Firms and institutions benefit from the disposal of more educated employees through two main channels: 1) through the positive effect of education and training on the improvement of productivity levels and rates of growth (Dearden *et al.*, 2000; Bresnahan, Brynjolfsson and Hitt, 2002), and 2) through the spill-over effects from better-educated workers. Therefore, the effects of higher levels of educational attainment are shown not only in the higher productivity of educated workers, but also in the increase of other workers' productivity as a result of learning by imitation and improving their skills from working with them (London Economics, 2005).

For society as a whole, the empirical evidence suggests that there is a positive relation between education (through human capital formation mechanisms) and economic growth (Lucas, 1988; Romer, 1990; De la Fuente and Ciccone, 2002; Jorgenson, Ho and Stiroh, 2005), with special force when technological change is considered (Psacharopoulos and Patrinos, 2004). These economic benefits estimations are usually based on gross wages across the economy and on the fiscal incomes derived from industries' economic growth.

There are also other social benefits that indirectly affect performance of economies through different channels. Education produces external effects that have a positive incidence on agents other than those benefiting from it. These externalities, such as social cohesion, political stability, and citizen participation in public policy issues, are difficult to identify and, even more so, to measure. Nevertheless, some authors have tried to identify and quantify educational externalities (Weisbrod, 1964; Havenam and Wolfe, 1984; Heckman and Klenow, 1997; McMahon, 2000; Acemoglu and Angrist, 2000; or Davies, 2002) by three main methods: 1) consumer surplus or welfare improvements, 2) expenditure on related private goods, and 3) hedonistic pricing models. The results of these studies show that the extent of social spill-overs explains the existence of significantly higher returns on investment in education for societies. The most plausible sources of these externalities are the link between human capital and the rate of technological change, and the indirect effect of education on productivity and employment through the quality of institutions that may be considered as a component of social capital (De la Fuente and Ciccone, 2002).

3. Some recent contributions to this field are: DE LA FUENTE (2003), HARMON, WALKER and WESTERGAARD (2001), CARD (2001), ASHENFELTER, HARMON and OOSTERBECK (1999), LASSIBILLE and NAVARRO GÓMEZ (1998), OECD (1998) and PSACHAROPOULOS (1994).

In addition, the increase of individual and social human capital allowed by e-learning provision and e-learning contribution to develop workers' e-skills may help to reduce skill-biased technological change effects on wage distribution in labour markets.

From the point of view of labour economics, it is well documented by both theoretical developments and empirical findings that technological change has a significant impact on the labour market. This topic has been an important concern of economic research, and the discussion has intensified in the two last decades due to the general ICT adoption in the economic sphere (Spitz, 2003). A key observation in this field is that highly skilled workers, and especially those with higher levels of educational attainment, are more likely to use computers in their job (Krueger, 1993). These facts have led to a major consensus in the labour economics literature that a burst of new technology causes a rise in the demand for highly skilled workers, which in turn implies an increase in the wages of skilled workers relative to unskilled workers. This hypothesis is known as the Skill-Biased Technological Change (Acemoglu, 2002; Acemoglu, 1998).

Some research (Berndt et al., 1992; Berman et al., 1994; Kaiser, 2000) has shown that during the last decades there has been a structural shift towards the increase in deployment of white-collar work in most sectors of developed economies and a rise in employment of workers with high levels of formal education. Moreover, other studies (Wolff, 2000; Autor et al., 2001) have found that the change in employment patterns resulted in an upgrading of cognitive and interactive skills and a decreasing demand for manual skills. This is simultaneous with the increase of ICT investment and adoption by firms. The link between ICT and the demand for high-skilled labour is due to the fact that the introduction of digital technologies alters the skill requirements of occupations in three main ways (Spitz, 2003): 1) ICT capital substitutes repetitive manual and repetitive cognitive activities, 2) ICT capital is complementary to analytic and interactive activities, and 3) ICT capital increases the requirement for computing skills. This relation underlies the evidence that compared to previous technological revolutions (that aimed to routinize manual tasks), digital technologies are additionally capable of replacing simple human cognition such as perceiving, choosing and manipulating processes, and searching and managing information. Additionally, computer technologies are complementary to analytical and interactive activities. There is also evidence that ICT capital does not

substitute whole occupations, but is limited to certain tasks. This limited substitution relationship, pointed out by Bresnahan (1999) shifts the demand for labour towards workers with higher levels of education who are considered to have a comparative advantage in performing analytical and interactive tasks. Thus, computer technologies shift the relative skills requirements of occupations towards analytical and interactive activities.

## E-learning in higher education

Universities stand at the centre of the knowledge-based economy development as they are currently one of the main agents providing education within the education industry.

There has been major development in the education industry in recent years in part as a consequence of the growing empirical evidence on the effect of improving educational attainment on economic and productivity growth. The increase of the education market has also been facilitated by the emergence and diffusion of digital technologies. The use of ICT in the production process that leads to the provision of education and training is transforming the way education suppliers are developing this. New opportunities have emerged to integrate pedagogical and technological resources, to increase flexibility across the learning process, and to improve communication between teachers and students and the interaction between different educational resources (Collis, 1996). The increasing use of ICT and particularly Internet in the educational process of universities across OECD countries explains the growing adoption of e-learning systems and the development of online courses in universities (European Commission, 2004; University of Southern California, 1990-2006; OECD/CERI, 2005).

The digital-based change in the provision of education is not constrained to the teaching and learning process, but also affects organisational structure and management practices of education suppliers.

Since the mid-nineties there has been an increasing belief that the use of e-learning systems in universities may lead to improved efficiency in the production of education, in terms of scale (number of student enrolments), students' achievement and costs (OECD, 1998).

Vilaseca and Castillo (2005) have studied six e-learning universities around the world<sup>4</sup> over a period of time

4. These universities are: Athabasca University (Canada), Capella University and Jones International University (United States), the Virtual University of Monterrey Technologic Institute (Mexico), the Open Learning Agency (Australia) and the UOC (Universitat Oberta de Catalunya), Spain.

in order to analyse the determinants of cost-efficiency in e-learning production by universities. The results show that cost-efficiency is due to three complementary effects: 1) the attainment of scale economies based on high fixed costs and low marginal costs; 2) the enablement of productive capacity expansion without an increase in fixed costs and 3) the trend towards a rise in variable costs consistent with decreasing marginal costs.

Therefore, e-learning production by universities will be accompanied with a relative high investment in ICT infrastructure and digital applications, as well as in methodological issues (course designs, didactic materials, etc.) and labour adjustments at the university level. This capital accumulation required for e-learning development may lead to a saving in costs, especially if universities are able to exploit some economic benefits based on the use of digital technologies.

There is already empirical evidence that e-learning policies in universities are important driving forces for quality improvement and strategic planning promotion. Following on from this, universities must continue with the research on efficient institutional models for the provision of high quality education based on the use of digital technologies.

## eLene-EE (Economics of e-learning)

In this special issue of RUSC on the economics of e-learning, some results of the eLene-EE project are presented in different papers. eLene-EE<sup>www1</sup> is a project of the eLene group (e-learning network) funded by the European Commission e-learning programme, running from February 2006 to July 2008.

The above sections contain the main questions eLene-EE researchers aim to address in order to discuss and provide evidence on which variables make virtual campuses and e-learning provision by European universities an efficient way to provide higher education: How much does it really cost to set up and run a virtual campus? What impact does e-learning have on student performance and what are the possible spill-over effects? What indicators do we have at our disposal to track the efficiency of e-learning? And can e-learning help to bridge the digital divide?

These topics are analysed in the four core content work-packages of the eLene-EE project:

[www1] <http://www.elene-ee.net/>

### WP 1. Cost-benefit analysis of net based higher education

The main question in WP1 is whether or not e-learning is an efficient use of resources, i.e. what are the main benefits and costs for society? One important aspect of the analysis is to consider effects, or outcomes, for different stakeholders (e.g. students, universities and policy makers). Although an investment may be beneficial for one stakeholder, it might not be beneficial for another. This raises the question of how costs and benefits should be divided between stakeholders in order to create a correct incentive structure.

### WP 2. Student performance of e-learning

The main questions in WP2 are whether the uses of ICT affect student performance and whether the uses of ICT affect student performance differently depending on the subject. These are two important questions that need attention in order to ensure quality in and efficient training from virtual mobility including the right choice of tools available from existing technology. WP2 aims to provide answers to these questions with hypotheses and data from ongoing training and data from a carefully designed experimental set-up performed within the WP. Students performing well are a condition for creating benefits in the context of WP 1.

### WP 3. Indicators of e-learning

The WP3 partners decided to work on indicators relevant at the HEI level and indicative of the regional, state or European ICT policy. Our aim is to collect data on indicators of e-learning progression in HEI with information characterising them and useful to aggregate and analyse data on policy perspectives. In consequence, we will work with a double approach. One is at the micro economic level, based on HEI business and management perspectives, integrating dimensions of the quality of services provided to the customer and specific indicators with a Balanced Score Cards approach. The other is at the macro economic level, looking at e-learning progression in our societies to identify indicators of its development.

## WP 4. Digital divides and e-learning

While the dividend of educational ICT seems obvious, countries may not meet the appropriate conditions in using these technologies and may fall into the digital divide. These technologies may enhance social exclusion and different groups within the societies will not benefit from them. The aims of this Work package 4 are threefold: Firstly, we want to characterize the variety of digital divides in matters of educational ICT and to understand how to bridge them. Secondly, we want to illustrate the differences of the digital divide in terms of uses, what factors contribute to it as well as its various forms. There will be a special focus on the concepts of digital choices and digital trajectories. Thirdly, we will look at the main explanations of digital divides in matters of performance. Why do some institutions, students, countries perform better than others? Is there any “productivity paradox” in the higher education sector? Is there a “Skill Biased Technological Change” in matters of educational ICT?

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## Recommended citation

CASTILLO, DAVID; SJÖBERG, MIKAEL (2008). "A Theoretical Framework for the Economics of E-learning". In: "The Economics of E-learning" [online monograph]. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 5, no. 1. UOC. [Accessed: dd/mm/yy].

<[http://www.uoc.edu/rusc/5/1/dt/eng/castillo\\_sjoberg.pdf](http://www.uoc.edu/rusc/5/1/dt/eng/castillo_sjoberg.pdf)>

ISSN 1698-580X



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## About the authors

*David Castillo-Merino*

Assistant Lecturer at the Department of Economics and Business of the UOC  
[dcastillo@uoc.edu](mailto:dcastillo@uoc.edu)

Dr. David Castillo-Merino holds a position as Assistant Lecturer at the Department of Economics and Business of the UOC. He is a member of the *New Economy Observatory* (IN3-UOC) research group. He is director of Masters in the field of Corporate Finance. His research interests and areas of expertise include: the economics of intangible assets, finance and innovation in firms, and e-learning and is an author of books and papers in these areas. He participates in the European eLene-EE project on the economics of e-learning.

*Mikael Sjöberg*

Umeå University  
[mikael.sjoberg@upc.umu.se](mailto:mikael.sjoberg@upc.umu.se)

Dr. Mikael Sjöberg has worked as a pedagogical consultant since 2000 at Umeå University and the Swedish University of Agricultural in Umeå. His main focus during this time has been ITC and learning in a university environment, both from the teacher as well as student perspective. He also has a doctorate in behavioural ecology as well as a degree for secondary school teaching (ages 16-19).

## Monograph “The Economics of E-learning”

## ARTICLE

# E-learning as a Regional Policy Tool: Principles for a Cost-benefit Analysis

*Niklas Hanes*  
*Sofia Lundberg*

Submitted: February 2008

Accepted: February 2008

Published: April 2008

## Abstract

A bill presented by the Swedish Government in 2001 stated that higher education should aim for a broader recruitment of students. The use of ICT-tools is pointed out as a way of reaching new student groups, e.g. students who are immobile due to their social situation or physical handicap. At the same time, a number of regions in Sweden struggle with negative net migration that is to a large extent driven by labour market conditions and younger people moving away for higher education. These regions experience a shortage of human capital within certain competence areas. In line with the aim of the government bill, national and local governments tackle this by integrating higher education and regional policy; i.e. bringing higher education to the inhabitants in an attempt to target groups such as those with strong bonds to the region hoping to encourage them to remain in the region after graduation. Higher education is costly and it is the local governments who bear the added cost of bringing education to the inhabitants. In order to minimize costs, programmes and courses are therefore given by the use of ICT-tools. The degree of net-based training (e-learning) varies over programmes and courses from 100 percent net-based to blended learning. At least three questions are important when deciding whether or not to invest in net-based higher education: Are new target groups reached? Is the net-based education of the same quality, or higher, compared to the alternative on-campus programme? Is the investment motivated from a welfare perspective? The aim of this paper is to analyse e-learning as a regional policy tool and present the principles for social cost benefit analysis concerning net-based higher education. In addition, empirical evidence from a Swedish case study is briefly presented.

## Keywords

cost-benefit analysis (CBA), economics of e-learning, net-based higher education, regional policy

**JEL classification:** D61, I21, I22, I28

## E-learning como herramienta de política regional: principios para un análisis de coste-beneficio

### Resumen

Un proyecto de ley presentado por el gobierno sueco en 2001 manifestaba que la educación superior debe fijarse el objetivo de atraer una mayor diversidad de estudiantes. Se habla de las herramientas TIC como un medio para llegar a nuevos grupos de estudiantes, p. ej., estudiantes que no pueden desplazarse debido a su situación social o a una discapacidad física. Al mismo tiempo, varias regiones de Suecia se enfrentan a una migración neta negativa que en gran parte está motivada por las condiciones del mercado de trabajo y por el desplazamiento de los jóvenes a otros lugares para poder acceder a la educación superior. Estas regiones sufren un déficit de capital humano en ciertas áreas de competencia. Haciendo frente común con el objetivo de este proyecto de ley del gobierno, los gobiernos nacionales y locales tratan de ofrecer soluciones integrando la educación superior y la política regional, es decir, llevando la educación superior a los habitantes en un intento de dirigirse a grupos como los que tienen fuertes lazos con la región, con la esperanza de alentarlos a quedarse en ella después de completar sus estudios. La educación superior es cara y los gobiernos locales son quienes se hacen cargo del coste adicional que supone llevar la educación a sus habitantes. Por tanto, para minimizar costes, se imparten programas y cursos con ayuda de herramientas TIC. El grado de formación impartido por Internet (e-learning) varía de un programa y curso a otro, desde un 100 por ciento de aprendizaje impartido por Internet a un aprendizaje de tipo mixto. Hay al menos tres cuestiones importantes a la hora de decidir si invertir o no en educación superior impartida por Internet. ¿Llega a nuevos grupos objetivo? ¿Es la educación impartida por Internet de la misma calidad, o superior, en comparación con el programa impartido en el campus? ¿Está motivada la inversión desde una perspectiva de bienestar social? El propósito de este estudio es analizar el e-learning como una herramienta de política regional y presentar los principios de análisis de coste-beneficio correspondientes a la educación superior impartida por Internet. Además, se presentan brevemente datos empíricos de un caso práctico sueco.

### Palabras clave

análisis de coste-beneficio (ACB), economía del e-learning, educación superior impartida por Internet, política regional

## 1. Introduction

In 2001 the Swedish Government presented its initiative to broaden recruitment to universities and university colleges.<sup>1</sup> One aim of the policy is to reach students from socially and ethnically underrepresented groups. The initiative also targets individuals who, due to physical handicap or social situation cannot move for higher education. The use of information and communication technology (ICT-tools) is mentioned as a means to target these groups (in the following this will be referred to as net-based education or training).<sup>2</sup> At the same time sparsely populated regions of Sweden (foremost inland) struggle with negative net migration, to some extent driven by younger people moving away for higher education (Eliasson, 2001). One consequence is that the municipalities experience a shortage of human capital. In order to mitigate this development the

national and local governments integrate regional policy and higher education by implementing net-based programmes and courses that otherwise are only available as on-campus education.

The purpose of this paper is to discuss net-based higher education (e-learning) as a regional policy tool in the context of a social cost-benefit analysis. The paper presents results from a case study in the northern part of Sweden (the Academy North<sup>3</sup> region) where a net-based nursing programme is analysed. The net-based nursing programme is compared to a similar on-campus programme, e.g. student characteristics and cost structure. Since the programme was initiated partly as regional policy, the case study contains a national analysis and a regional analysis in order to highlight the incentives of the stakeholders to promote the programme, i.e. the university, the region and the national government. The difference between the regional

1. Proposition 2001/02:15.

2. Proposition 2001/02:04.

3. The Academy North is a consortium of 13 municipalities in the four counties that define northern Sweden.

and national analysis depends on which costs and benefits are considered. In the national analysis, all costs are taken into account and all students and their future income flows are considered, regardless of the place of residence. In the regional analysis, only funding by municipalities in Academy North is considered and students working outside the region after their exams are not taken into account. This means that regional costs are lower compared to national costs. However, on the benefit side, the region is vulnerable to out-migration of the labour force. If a newly-educated nurse migrates from the region, the region loses the expected benefit; as long as the individual migrates within Sweden, the national analysis is indifferent between places of residence. In the case study, three important questions are highlighted. Firstly, is it possible to reach new student groups by the use of e-learning tools? Secondly, are e-learning programmes and courses of the same quality as similar on-campus education? Thirdly, are investments in e-learning motivated from a welfare perspective? The latter discussion also concerns different incentives among stakeholders that may constitute restrictions when e-learning programmes are implemented.

The social cost-benefit analysis is essentially a tool for supporting decision-making by the government. At a given point in time the society has a given amount of resources, such that politicians are faced with the problem of ranking different policy options. Cost-benefit analysis is used to answer the question whether resources within a project are used efficiently for the society as a whole compared to an alternative case. The decision rule is very simple; select the alternative if the net benefit of the investment is higher compared to the next best project. This ranking implies that the costs of the best project are the benefits of the next best project. Thus, the social cost-benefit analysis is generally concerned with the "alternative case" and what would have been done in the alternative case.

The social cost-benefit analysis should not be confused with traditional analysis of net present values of financial costs and benefits. The objective function in a social cost-benefit analysis is citizen welfare and the objective of the financial appraisal is profit maximisation or a balanced budget. Perhaps the right question to pose is why net present values of financial costs and benefits are not a sufficient decision basis for ranking policy options. The simple answer is that the concept of citizen welfare is much broader than market concerns, i.e. effects that are not assigned market prices. Furthermore, from a policy viewpoint, the social consequences of a project may be of great importance, e.g. intertemporal concerns or distributional consequences for different groups in the society.

However, it is important to note that the direct financial costs and benefits are important, since a department or university will not provide a course or a programme that is unprofitable. Thus, an investment that may be beneficial in the context of social cost-benefit analysis may not be realised since financial burdens affect incentive structures for stakeholders.

This paper is organised as follows. In the next section we present the basics of cost-benefit analysis and the application to the present case study. Section three is a summary of the case study, and section four contains a short discussion.

## 2. Cost-benefit analysis

The social cost-benefit analysis (CBA) is a tool for supporting decision-making by governments ranging from international to local levels. The welfare of the citizens is the primary interest in a cost-benefit analysis. In the best of worlds, a cost-benefit analysis considers all effects that directly or indirectly affect the welfare of the citizens.

The starting point for the analysis is that aggregate production (GDP) requires resources today while giving consumption opportunities today or in the future. Put simply, the main benefit of a project is the value of the production increase that follows. The main purpose of the cost-benefit analysis is to evaluate whether resources are used efficiently in a project compared to some reference alternative. This builds on the assumption that resources are scarce and as such always have an alternative use. The values of the alternative use are the costs that are associated with the project. Thus, the effects that are generated by a project, measured in costs and benefits from a society perspective, must be compared to an alternative situation, e.g. when the project is not implemented.

As mentioned earlier, social cost-benefit analysis should not be confused with the analysis of financial net present values. With higher education as an illustrative example, a financial analysis of the costs and benefits of an investment targets a department, a faculty or the university, while a (social) cost-benefit analysis focuses on the same investment but considers its effects on the society as a whole. A department, for example, facing an investment in an online-based course or programme is probably concerned with the opportunities of scale in terms of more students reached per teacher hour invested or if it could lead to increased quality compared to face-to-face training and better student performance (Lundberg, 2007; Coates

*et al.*, 2004; Brown and Liedholm, 2002). This analysis ends when the student leaves the education programme. A cost-benefit analysis also follows the student after training and considers the potential productivity increase as well as non-marketed effects that may follow from higher education.

A cost-benefit analysis is characterised by the transformation of all effects to monetary values including those which are not associated with actual transfers of money. Some effects are of course very difficult to express in monetary terms. It is inevitable that a cost-benefit analysis concentrates on effects that can be quantified. In the following sub-section, the basic steps of a cost-benefit analysis will be presented.<sup>4</sup> The structure of a cost-benefit analysis may of course differ for different applications but in general it includes the following steps:

1. Identification of costs and benefits
2. Quantification of costs and benefits
3. Calculation of net present values
4. Decision criteria
5. Sensitivity analysis

## 2.1. Identification of costs and benefits

The main benefit of education is the potential effect on productivity. Education is expected to enhance knowledge and skills, which in turn affects productivity and income, which is beneficial for the individual as well as for the society. A possible way to measure productivity is to study wages. There is extensive empirical literature on the wage premium of higher education. When cost-benefit analysis is conducted in connection to the implementation of an education programme it is difficult to rely on estimated wage premiums since a relatively long period after graduation is required in order to identify the effect. Therefore, case studies can for example be based on observed wages before and after education or observed wage statistics for the specific work category. However, this kind of measure is imprecise and can not reveal the real effect of the particular education programme that is studied.

It is possible to think of other benefits that are non-marketed but nonetheless important to consider, e.g. benefits that an individual may experience from education, other than receiving a job and higher earnings. In the regional

analysis, individuals are given the opportunity to stay in their region and study and work, although this opportunity is clearly beneficial for the individual and the region, the monetary value is difficult to determine. However, since net-based higher education is a policy tool for reaching new student groups and to encourage an educated labour force to stay in sparsely populated areas, the government has put a certain value on these effects.

### 2.1.1. Costs

In the context of a cost-benefit analysis, costs are defined as opportunity costs, i.e. the value of the resources in an alternative use. Taxes and transfers are generally not seen as costs in the cost-benefit analysis. Taxes and transfers represent flows of income between individuals and sectors in the economy. For example, study loans and study grants are transfers and not a cost in the context of a cost-benefit analysis. However, the external effects that are caused by taxes may generate costs (the marginal cost of public funds). There are two different ways to approach the costs of an investment. One is to see the investment as having a partial effect on the economy (small projects). This means that the investment does not affect the relative prices in the economy. The other way is to analyse the investment in a general equilibrium framework, i.e. the investment alters relative prices, which will have consequences for the whole economy (large projects). The case study discussed later only considers the partial effect.

The costs associated with an education programme may be sorted into the following categories:<sup>5</sup>

- Production losses
- The value of the personnel in the alternative case
- The value of the premises in the alternative case
- Depreciation of inventories
- Goods and services associated with the education

### 2.1.2. Production losses

There is an important production loss as a result of students who choose to study. The value of the production in the alternative case must be considered in the cost-benefit analysis. Consequently, the alternative cost of an unem-

4. See e.g. LAYARD and GLAISTER (1994), HULTKRANTZ and NILSSON (2004), BRENT (2006).

5. This classification follows AXELSSON and LÖFGREN (1992).

ployed person taking part in a project is zero, or equal to the individual's utility from leisure. If it is assumed that the labour market is in equilibrium we know that the student's utility from leisure is at least as large as the wage they could have had if they had chosen to work. If the student had been employed prior to education this is a good approximation of the value of the production losses.

### 2.1.3. The value of the personnel in the alternative case

Implementing a new education programme requires more working hours for university teachers. It may be difficult to obtain information about their activity in the alternative case. However, a reasonable assumption is that the value of their contribution to production in the alternative case is the same as the cost that arises in the programme that we study. Another possible outcome is that the university values the experience of the teacher gained from working with net-based training compared to traditional face-to-face (if this is the alternative) and that this is expressed as an increase in wage that otherwise would not have been the case. If so, the added value of increased knowledge should be included in the analysis.

### 2.1.4. The value of the premises in the alternative case

Provision of net-based programmes involves the use of university premises to some degree. Streamed video lectures need to be recorded, teachers and administrative staff need offices and so forth. Furthermore, if face-to-face meetings with the students are scheduled, premises are needed. The use of these premises has an alternative value. Therefore the cost (such as rental and depreciation) should be included.

### 2.1.5. Depreciation of inventories

As in the case of premises, inventories such as office furniture and equipment have an alternative use and therefore an alternative cost that needs to be considered. The depreciation value is the best approximation to the alternative cost for inventories.

### 2.1.6. Goods and services

If development and implementation of the programme is associated with the purchase of goods and services, they

have to be included in the calculation of the total cost. A service could for example be promotion costs paid to an advertising agency.

## 2.2. Quantification of costs and benefits

Estimations of future production values as well as different costs are by nature associated with a high degree of uncertainty. When conducting case studies, surveys and official labour market statistics can be used in order to quantify costs and benefits. Calculations of production losses can be based on wages that are reported in the surveys, i.e. the wage prior to the education programme.

For several reasons, it is very difficult to predict future production values, e.g. to what extent is higher education expected to affect labour market behaviour such as labour supply and retirement age? Some assumptions have to be made, e.g. that labour market behaviour is not affected by the individual's education choice. The assumption of similar labour market behaviour between the two cases is a very simplified assumption that may be questionable, e.g. in a regional analysis it is likely that education and career choices do affect migration decisions. Furthermore, it is difficult to estimate future productivity changes; one (risky) assumption is that productivity increases are the same between the two cases, i.e. the case where the individual chooses the education programme (the case observed) and the alternative case where the individual stays in the former occupation.

A cost-benefit analysis of a net-based programme or a course necessitates that the departments and other organisations involved in the development and performance of a programme identify and estimate all costs. This includes direct as well as indirect costs. It is important to note that the figures that appear in the budget are not the true alternative costs. However, it is reasonable to assume that these figures represent the value of the resources in the alternative case, e.g. why should the value of a computer or a teacher be different in another situation? Some costs may be difficult to estimate, e.g. extra time spent by ambitious teachers in the development phase. One way to collect this data is to perform interviews and ask involved teachers about time spent outside work time.

## 2.3. Calculation of net present values

An education programme gives rise to costs today while the main benefits arise in the future; i.e. production values up to the year of retirement. Future costs and benefits

have to be discounted in order to be comparable. A project requires resources today, which means that consumption opportunities today are restricted. A positive discount rate implies that individuals prefer consumption today compare to consumption in the future. The basic criterion is that the discount rate should reflect the individual's time preference discount rate. In a perfect market economy the time preference rate equals the interest rate that reflects the individual's choice of consumption today and in the future. In reality there is no unitary interest rate. Since the choice of discount rate to some extent is arbitrary, the effect of different rates should be analysed.

#### 2.4. Decision criteria

The net present value is used as the decision criteria in this analysis. The costs and benefits are discounted to present values and if the discounted benefits exceed the discounted costs, the net social benefit is positive.<sup>6</sup>

#### 2.5. Sensitivity analysis

There are several sources of uncertainty in the analysis. Thus, it is very important to evaluate how sensitive the result is for small changes in key variables. One key factor in the cost-benefit analysis is the discount rate. A higher discount rate implies that the present value of future benefits and costs decreases. Due to the fact that the choice of discount rate is arbitrary to some extent, it is important to evaluate how sensitive the result is to changes in the discount rate.

### 3. A case study of a nursing programme

In this section we briefly present some results from a case study of a nursing programme in Sweden. The discussion is mainly based on Fähræus and Lundberg (2002) and Lundberg (2005). The case study illustrates a possible strategy for analysing an e-learning programme in the context of a social cost-benefit analysis. Some key questions are highlighted in the case study, e.g. is it possible to reach new student groups that otherwise would not have participated in traditional on-campus education? Are there quality differences between

e-learning programmes and on-campus programmes? A nursing programme provided on campus by Umeå University has been used as a comparison. One purpose of the case study is to discuss net-based higher education as a regional policy tool. Different interests at the national, regional and local level are identified which may affect the implementation of this kind of investment. Some key elements of the case study are now briefly discussed.

An extensive survey has been used to collect data describing student characteristics. The survey contained questions including those concerning age, family, education, occupation prior to education and labour market outcome.

#### Background

The inland of the northern part of Sweden is sparsely populated and the majority of municipalities are struggling with depopulation and shrinking tax bases. The region has, for a long time, been characterised by negative net migration, a process that is driven by labour market conditions and people moving away for higher education. One consequence of this development is that there is the risk of a shortage of human capital within some areas, for example health care. The nursing programme analysed in the case study was initiated by Academy North, a consortium of 13 municipalities as a direct response to the lack of nurses in the region. The nursing programme was hosted by the Lycksele municipality (130 km from Umeå), where a study centre was located. The nursing programme was provided by the Nursing Department at Umeå University.

#### Stakeholders

One important aspect is that several stakeholders are involved, with three main stakeholders, the Academy North, the Ministry of Education and Umeå University sharing the costs for the programme. It is important to identify the stakeholders since the outcomes for the different stakeholders may constitute important restrictions for the implementation of this kind of project. In this paper, the investment decision is seen from two perspectives, Academy North and the national government. This is done in order to highlight the regional dimension of the investment.

The national government provided resources to the same extent as for on-campus education; added costs for

6. Net present value =  $\sum B_t/(1+i)^t - \sum C_t/(1+i)^t$ , where  $B$  is benefits,  $C$  is costs,  $i$  represents the discount rate and  $t$  the time period.

the net-based programmes are financed by the municipalities. It is therefore important to conduct the cost-benefit analysis for the national government as well as for the region (the consortium of municipalities). This approach can identify different incentives for the stakeholders, but also the pre-requisites for successful investment from the perspective of the different stakeholders. It should be noted that higher education in Sweden is free; there are no fees at all for the students.

## The students

People from all regions in Sweden were allowed to apply. However, the majority of the applicants were settled in the region. The students were enrolled in 2002 and examined in 2005. A similar nursing programme was provided on-campus by the same department of nursing, such that the student group on the net-based programme can be compared to the corresponding on-campus programme. This is important in order to study the characteristics of the students. A previous study concludes that the nursing programme was able to attract a new student group (Fåhraeus and Lundberg, 2002). The study indicated that the students were older compared to the on-campus programme and were also more likely to have family and children.

## The net-based nursing programme

The nursing programme extended over three years. Students had practical sessions at a clinical training centre and a final practical at a hospital. The students on the net-based programme were equipped with laptops, cameras, technical support, etc. This equipment and the investment in the clinical training centre generated the additional costs compared to the on-campus programme. Without discussing the quality of the training thoroughly we refer to the study by Lundberg (2005) that argues that the students felt that there were no quality differences between the on-campus programme and the net-based programme. Quality was for example measured as teacher accessibility.

## The labour market

Since the cost-benefit analysis is concerned with the effect of education, the labour market conditions may have a

major impact on the results, especially when a single programme is studied. In the region, short time fluctuations in the demand for nurses have been observed, mainly because of resource bottlenecks in the public care system. Health care in Sweden is mainly publicly provided and the labour market conditions for nurses are generally seen as very good, at least in the longer run (see e.g., Arbetsmarknadstytelsen, 2001; 2005). Municipalities and county councils employed most of the students on both programmes.

## The labour market entry

Some differences between the net-based programme and the on-campus programme can be observed. Students on the net-based programme applied for 1.7 positions on average and 42 percent had a temporary position. Students on the on-campus programme applied for 5.7 positions on average and 63 percent had a temporary position. Some differences in labour market outcomes were observed between the net-based programme and the on-campus programme. At the time of graduation, 10 percent of the on-campus students were employed compared to 65 percent for the net-based programme. The corresponding figures after one year were 89 and 93 percent, a much smaller difference. One important question is whether these differences were due to the selection of students or treatment effects. It is reasonable to believe that it is foremost an effect of student selection and different conditions in the labour market.

## Workplace after exam

The actual workplace after graduation corresponds to a large extent to a previous study where the students reported their preference for workplace after graduation (see Fåhraeus and Lundberg, 2002). The results indicate that Academy North succeeded in its intention to encourage local students not to migrate after graduation. Almost all students remained within the region after graduation. The results also indicate that students from the on-campus programme were not interested in working in the Academy North region. Thus, the net-based nursing programme had a positive effect on the recruitment of nurses to this region. This is a very important observation since migration is the key factor in the regional cost-benefit analysis, i.e. to what extent the municipalities find their investment beneficial.

## The alternative case for the cost-benefit analysis

A majority of the students reported that the on-campus programme was not an option. This is also an important observation as it indicates that the net-based programme actually attracted a new student group. It also indicates that the relevant alternative case is when students do not attend the programme on-campus and continue the occupation they had prior to the period of study.

## Benefits

We have discussed the main benefits from the programme in the context of a cost-benefit analysis. The wage one year after exams has been used as an approximation of the production value. We have assumed that there is no future productivity increases (or more specifically that they are outweighed by productivity increases in the alternative case). Other benefits that are not measured as monetary values but that may be important in a sensitivity analysis are e.g. student satisfaction from education, higher ability or new competence of teachers, and regional spill-overs from less out-migration. The benefits included may thus be seen as a minimum level of benefits.

## Costs

The main cost is the production loss that arises when students choose to study instead of continuing their occupation. The production loss is estimated using the income for the occupation prior to the education that is reported in the survey. The Department of Nursing provided the data on costs for the net-based nursing programme, e.g. resources associated with teachers, goods and services, inventories and premises. As mentioned before, it is important to note that the figures that appear in the budget are not the true alternative costs. However, it is reasonable to assume that these figures represent the value of the resources in the alternative case.

Costs were defined as development costs, direct costs, and administrative costs. The costs were significantly higher on the net-based programme compared to the on-campus programme. The costs that were added compared to the on-campus programme, were financed by the municipalities (Academy North).

## Results

The time scale of the analysis is between 2002 (programme start) and the year when the individual turns 65. Present values of costs and benefits are calculated using discount rates between two and six percent. For discount rates within a reasonable interval (2 - 6 percent) the net present value for the regional analysis is positive. However, the national analysis that considers all costs gives a negative net present value for higher discount rate (4 - 6 percent). The results from the case study clearly indicate that from the municipality's point of view, their investment is beneficial for the region and the funding from the state is merely a regional support. The project is less beneficial for the state, which is natural since they consider all costs in the analysis, and given the benefits that are included.

What factors are important for the result? Firstly, student performance is obviously important. The results are sensitive to changes in student performance. Programmes with few students are therefore more vulnerable. Secondly, labour market outcomes and labour market conditions obviously are important; the lack of nurses in the region is the main objective for starting the programme. The most important factor for the regional analysis is migration; if students move away after the final exams, the regional benefit is lost. However, for the national analysis, the result is not dependent upon migration within Sweden as long as the regional dimension is not considered.

## 4. Discussion

This short paper has briefly discussed e-learning in the context of social cost-benefit analysis. A short summary of a case study concerning a net-based nursing programme has also been presented. A main purpose of the paper is to discuss e-learning as a potential regional policy tool. The results from the case study indicate that e-learning may be used successfully to achieve regional goals, e.g. to mitigate a lack of a specific competence in the labour market. The results also indicate that it is important to consider different incentive structures since they affect the willingness to provide or fund investment in e-learning. Several major effects that are important for social-cost benefit analysis have not been estimated. For example, what is the benefit to an from higher education and the option to stay in the home region? What is the benefit of having nurses and health care in the region? And are there regional spill-overs? As a consequence, the benefits of the investment are most likely

to be greater than we have estimated. This kind of case study raises some important questions on whether it is a good policy to combine regional policies and education policies. Can this kind of policy combination be efficient in fulfilling the EU policy goals of regional cohesion?

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## Recommended citation

HANES, NIKLAS; LUNDBERG, SOFIA (2008). "E-learning as a Regional Policy Tool: Principles for a Cost-benefit Analysis". In: "The Economics of E-learning" [online monograph]. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 5, no. 1. UOC. [Accessed: dd/mm/yy].

<[http://www.uoc.edu/rusc/5/1/dt/eng/hanes\\_lundberg.pdf](http://www.uoc.edu/rusc/5/1/dt/eng/hanes_lundberg.pdf)>

ISSN 1698-580X



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## About the authors

### *Niklas Hanes*

Assistant Professor at the Department of Economics at Umeå University  
[niklas.hanes@econ.umu.se](mailto:niklas.hanes@econ.umu.se)

Dr. Niklas Hanes, PhD in economics, works as an Assistant Professor at the Department of Economics at Umeå University. He has worked with research projects concerning efficiency in the public sector and especially interdependencies in economic federations, and labour and education economics, mainly focused on non-cognitive skills and their effect on labour market behaviour and wage premiums. In 2004 he was contracted by the National Agency for Higher Education in Sweden to analyse the economic effects of an extended academic year. He participates in the European eLene-EE project on the economics of e-learning.<sup>[www1]</sup>

### *Sofia Lundberg*

Assistant Professor at the Centre for Regional Science at Umeå University  
[sofia.lundberg@econ.umu.se](mailto:sofia.lundberg@econ.umu.se)

Dr. Sofia Lundberg holds a position as Assistant Professor at the Centre for Regional Science at Umeå University. She has a PhD in economics and has been working at the centre since 2001. She works with research and education in the field of regional economics. She is the project manager of the *Evaluation of net-based education in nursing* project which deals with questions like “Why a netbased nursing programme in Lycksele?” and “How was it done?” She also works with evaluation of student collateral and student–student / teacher–student communication. She participates in the European eLene-EE project on the economics of e-learning.<sup>[www1]</sup>

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[www1] <http://www.elene-ee.net/>

## Monograph “The Economics of E-learning”

## ARTICLE

# E-learning and Labour Market: Wage-premium Analysis

*David Castillo-Merino, PhD**Jordi Vilaseca-Requena, PhD**Enric Serradell-López**Natàlia Valls-Ruiz*

Submitted: February 2008

Accepted: February 2008

Published: April 2008

**Abstract**

The link between ICT and the demand for high-skilled labour is due to the fact that the introduction of digital technologies alters the skill requirements of occupations in three main ways (Spitz, 2003): 1) ICT capital substitutes repetitive manual and repetitive cognitive activities, 2) ICT capital is complementary to analytic and interactive activities, and 3) ICT capital increases the requirement for computing skills. Within this framework, we have analysed the determinants of labour productivity of individuals that have taken higher education programmes online to test how occupational skill requirements and the degree of ICT adoption by the industry matches skills of online students. In order to do this, we have assumed an implicit relationship between education and ability (Griliches and Mason, 1972), recognizing that online students may acquire specific skills, such as computing skills and abilities related to ICT use. For the empirical analysis we have used a database of degree students from the UOC (Universitat Oberta de Catalunya). The results from our model based on Mincerian equations show three important facts: 1) schooling is not a significant variable to explain wage differentials; 2) experience, understood as previous productivity and production losses avoided, is the most important variable explaining improvement of wages; and 3) ICT skills have a positive and significant effect on wage levels.

**Keywords**

e-learning, labour market, wages, labour productivity, ICT skills

JEL Classification: D61, I21, I22, I28

## E-learning y mercado de trabajo: Análisis de primas salariales

**Resumen**

El vínculo entre las TIC y la demanda de personal altamente calificado se debe a que la introducción de las tecnologías digitales altera los requisitos de calificación de los puestos de trabajo de tres formas principales (Spitz, 2003): 1) el capital de las TIC sustituye actividades manuales y cognitivas repetitivas, 2) el capital de las TIC complementa las actividades analíticas e interactivas, y 3) el capital de las TIC aumenta los requisitos en cuanto a destrezas informáticas. En este marco,

hemos analizado los determinantes de la productividad laboral de personas que han seguido programas de educación superior por Internet para comprobar de qué forma los requisitos de capacidades ocupacionales y el grado de aplicación de las TIC por la industria se corresponden con las capacidades de las personas que han seguido cursos por Internet. Para llevar a cabo este análisis, hemos asumido que existe una relación implícita entre la educación y la capacidad (Griliches y Mason, 1972) reconociendo que las personas que han seguido cursos por Internet pueden adquirir habilidades específicas, como destrezas informáticas y habilidades relacionadas con el uso de las TIC. Para el análisis empírico, hemos usado una base de datos de estudiantes diplomados por la UOC. Los resultados de nuestro modelo basado en ecuaciones de tipo minceriano muestran tres hechos importantes: 1) la educación no es una variable significativa para explicar las diferencias salariales; 2) la experiencia, entendida como productividad previa y elusión de pérdidas de producción, es la variable más importante para explicar las mejoras salariales; y 3) las destrezas de uso de las TIC tienen un efecto positivo y significativo en los rangos salariales.

### Palabras clave

e-learning, mercado de trabajo, salarios, productividad laboral, destrezas en el uso de las TIC

## 1. Introduction

International literature provides clear empirical evidence that education leads to major benefits, both for individuals and for society as a whole. In economic terms, human capital accumulation as a result of the educational process must be considered a mixed good, i.e. a private good with positive public externalities. The nature of educational goods leads to the distinction between private and social educational benefits.

From the private benefits point of view, and following human capital theory approach, the increase in individuals' level of educational attainment is consistent with an increase in their productivity in the labour market, which explains higher wages for more educated workers. Since Mincer (1974), who estimated that individuals' schooling accounted for around 10% of wage increases in the USA, to today, a large amount of empirical evidence<sup>1</sup> demonstrates a high positive correlation between individuals' educational levels and wages. Therefore, taking into account age and experience, better-educated workers earn more than their less-educated peers (Cipollone, 1995). However, education is not the only explanatory variable of wage differentials. There are other variables, sometimes difficult to measure, that affect labour market outcomes: individuals' innate ability, social and economic status, family background and other social factors. But, as pointed out by Hinchliffe (1995), earnings functions and path analysis of the effects

of individuals' background characteristics on occupational attainment and income have indicated that, while much of the variance remains unexplained, the most important single indicator is education. Indeed, it has also been proven that a virtuous circle arises within the complementary relations between education and income, so that education can explain higher earnings for workers while higher income causes increases in the demand for education (Sianesi and Van Reenen, 2002).

Other individual benefits from higher levels of education, directly related and complementary to wages, are 1) the higher likelihood of participating in the labour market and 2) the lower of being unemployed. Participation in the labour market and unemployment rates are closely related to education (OECD, 1997 and 1998; de la Fuente, 2003) and help to explain the economic benefits for individuals.

An important concern is that benefits of educational investments for individuals extend beyond increases in earnings and employment conditions to other factors that have an indirect effect on economic benefits. In this sense, education has a positive impact, among other factors, on health (Taubman and Rosen, 1982; Desai, 1987), on intergenerational cognitive development (Angrist and Lavy, 1996; Lam and Dureya, 1999), on developing more rational organizational and financial competence, and better analytical skills (Lassibille and Navarro Gómez, 2004), on increasing the likelihood of participating in politics and social decision mechanisms (Campbell *et al.*, 1976), on adopting a better

1. Some recent contributions to this field are: DE LA FUENTE (2003), HARMON, WALKER and WESTERGAARD (2001) CARD (2001), ASHENFELTER, HARMON and OOSTERBECK (1999), LASSIBILLE and NAVARRO GÓMEZ (1998), OECD (1998) or PSACHAROPOULOS (1994).

consumption technology and a greater efficiency in making consumption choices (Rizzo and Zeckhauser, 1992) and on higher saving rates (Solomon, 1975). All these additional advantages are real benefits from education but they are difficult to measure in monetary terms.

From a social point of view, education plays an important role in determining the level and the distribution of income, in productivity and in economic growth of firms (and institutions in general).

Firms and institutions benefit from having more educated employees at their disposal through two main channels: 1) through the positive effect of education and training on the improvement of productivity levels and rates of growth (Dearden *et al.*, 2000; Bresnahan, Brynjolfsson and Hitt, 2002), and 2) through the spill-over effects from better-educated workers. Therefore, the incidence of higher levels of educational attainment is shown not only in the higher productivity of educated workers, but also in the increase in productivity of other workers as a result of learning by imitation and improving their skills from working with them (London Economics, 2005).

For the society as a whole, the empirical evidence suggests that there is a positive relationship between education (through human capital formation mechanisms) and economic growth (Lucas, 1988; Romer, 1990; de la Fuente and Ciccone, 2002; Jorgenson, Ho and Stiroh, 2005), particularly when technological change is considered (Psacharopoulos and Patrinos, 2004). These economic benefit estimations are usually based on gross wages across the economy and on the fiscal incomes derived from economic growth of the industry.

There are also other social benefits that indirectly affect performance of economies through different channels. Education produces external effects that have a positive impact on agents other than those benefiting from it. These externalities, such as social cohesion, political stability, or citizen participation on public policy issues, are difficult to identify and, especially, to measure. Nevertheless, some authors have tried to identify and quantify educational externalities (Weisbrod, 1964; Havenam and Wolfe, 1984; Heckman and Klenow, 1997; McMahan, 2000; Acemoglu and Angrist, 2000; or Davies, 2002) by three major methods: 1) consumer surplus or welfare improvements, 2) expenditure on related private goods, and 3) hedonic pricing models. The results of these studies show that the measure of social spill-overs explains the existence of significant higher returns to investment in education for societies. In fact, the most plausible sources of these externalities are the link between human capital and the rate of technological change, and the indirect effect of education on productivity and employment through the quality of institutions

that may be considered a component of social capital (de la Fuente and Ciccone, 2002).

In addition, the increase of individual and social human capital acquired through e-learning provision and e-learning contribution to develop workers' e-skills may help to reduce skill-biased technological change effects on wages distribution in labour markets.

## 2. Costs and benefits from education

Costs and benefits can be combined in several ways for a cost-benefit analysis. The most common methods are rates of return, cost-benefit (and benefit-cost) ratios and net present values. The estimation of internal rates of return on investment, i.e. the interest rate that equates the present values of benefits and costs (Psacharopoulos and Woodhall, 1985), captures the complete picture of the costs and benefits of education and, therefore, it demonstrates which forms of investment produce the best value for money.

The rate of return to investment in education is a measure of the future net economic payoff to an individual or society of increasing the amount of education offered (Carnoy, 1995). It is calculated by setting the discounted value of costs ( $C_t$ ) and benefits ( $B_t$ ) over time equal to zero and solving for the implicit discount rate  $r$ :

$$\sum \frac{B_t}{(1+r)^t} = \sum \frac{C_t}{(1+r)^t} \quad (1)$$

Private rates of return for individuals and rates of return for society are estimated, in which private benefits are added to those accruing to firms and society, and private costs are also added to costs incurred by firms and society (table 3).

From the standpoint of the individual, to estimate the private rates of return, private costs and benefits must be computed. The benefits of additional education are the additional income the individual earns as a result, the non-economic consumption benefits that educational investment provides over a person's life, and the direct consumption benefits derived from the educational process. However, in measuring private rates of return, economists have limited themselves to the earnings benefits of education (Carnoy, 1995).

From the standpoint of society, social costs and benefits must be estimated. Social benefits are usually estimated by using the same average earnings streams as in the private rates of return calculation, corrected for income taxes.

Therefore, in order to analyse the economic return effects from education investment, two different types of discount rates must be estimated:

1) The private rate of return to education ( $r_p$ ) through the discounted value of private costs (PC) and benefits (PB):

$$\sum \frac{PB_t}{(1+r_p)^t} = \sum \frac{PC_t}{(1+r_p)^t} \quad (2)$$

2) The social rate of return to education ( $r_s$ ), defined as the relation between social costs (SC) and benefits (SB):

$$\sum \frac{SB_t}{(1+r_s)^t} = \sum \frac{SC_t}{(1+r_s)^t} \quad (3)$$

Where:

$SB = PB + UB$  UB = Benefits accrued by firms and society.

$SC = PC + UC$ ; UC = Costs incurred by firms and society.

TABLE 1. Rates of return to education

Rates of return to education				
Private benefits	+	Benefits to firms and society	=	Social benefits
-				-
Private costs	+	Costs by firms and society	=	Social costs
=				=
Private rate of return				Social rate of return

Source: London Economics (2005)

### 3. Estimating the returns to education. Theoretical models

There are two principal methods used in estimating rates of return to education: the “traditional method” and the “Mincer method”.

The traditional method takes into account calculated annual costs and earnings by education level. To estimate private returns to education direct and indirect costs carried by individuals are added to opportunity costs (earnings foregone). And these are added to public costs to estimate annual social costs for the social rate of return. Annual private and social benefits are calculated from the difference in average earnings of those who have different levels of education. For the private rate income differences are estimated using net values, but for the social rate gross income figures are used. These annual costs and benefits are inserted into equation (1) to estimate the discount rate that makes costs and benefits equal.

The Mincer method uses regression analysis to fit a Mincerian human capital earnings function. The clas-

sical specification used to estimate the effect of individual schooling on wages has been the following (Mincer, 1974):

$$\ln W_i = \alpha + \theta S_i + \gamma E_i + \mu E_i^2 + \varphi X_i + u_i \quad (4)$$

Where W is the wage (earnings), S the years of schooling, E the experience, X a set of individual characteristics, and u the variation in log-wages not captured by the computed variables. The parameter  $\theta$  measures the percentage increase in wages associated with an additional year of schooling. Under certain conditions (which include the assumption that there are no direct costs of education)  $\theta$  can be interpreted as the private rate of return to schooling. This is why  $\theta$  is known as the *Mincerian return to schooling* and also as the schooling wage-premium or as the *gross return to schooling* (de la Fuente and Ciccone, 2002).

The reasoning behind this calculation is that partial differentiation of  $\ln W$  with respect to S gives a method of the calculation of rates of return (Carnoy, 1995), in a continuous form:

$$\theta = \frac{\delta h W}{\delta S} \tag{5}$$

And also in discrete form:

$$\theta = \frac{\ln W_s - \ln W_o}{\Delta S} \tag{6}$$

Where  $W_s$  and  $W_o$  refer to the earnings of those individuals with  $s$  and  $o$  years of schooling, respectively.

Therefore, marginal rates of return to particular levels of education can be estimated from Mincerian regressions by substituting a string of dummy variables for each level of schooling.

Rates of return have been estimated for a large number of countries, by types and levels of education, by gender, and, for some countries, over time (Psacharopoulos and Patrinos, 2004).

TABLE 2. Returns to investment in education by level, full method, regional averages (%), 2003

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia*	16.2	11.1	11.0	20.0	15.8	18.2
Europe/Middle East/North Africa*	15.6	9.7	9.9	13.8	13.6	18.8
Latin America/Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
OECD	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8
World	18.9	13.1	10.8	26.6	17.0	19.0

\* Non-OECD

Source: Psacharopoulos and Patrinos (2004)

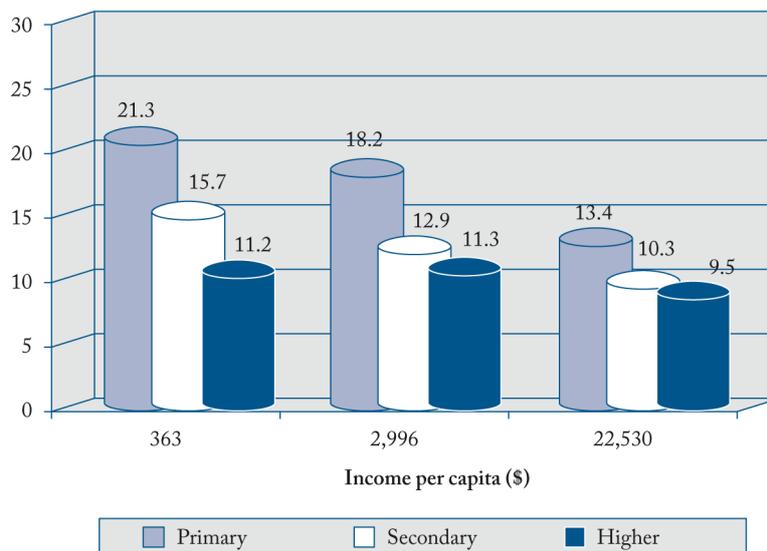


FIGURE 1. Social returns to investment in education by income level  
Source: Psacharopoulos and Patrinos (2004)

The return to education is negatively related with the level of economic development of the country. This relation can be seen at all education levels (primary, secondary and higher education) but is most observable in the primary and secondary levels of education. Nevertheless, the major return to education of the primary and secondary education is a common pattern over time and across the countries. Indeed the classical pattern of falling returns to education by level of economic development and level of education are maintained (Psacharopoulos and Patrinos, 2004).

#### 4. Education and wages: the role of ICT in the relationship between e-learning and labour productivity

From a labour economics point of view, published theories and empirical findings demonstrate that technological change has a significant impact on the labour market. This topic has been an important concern of economic research, and the discussion has intensified in the two last decades due to generalized adoption of ICT in the economic sphere (Spitz, 2003). A key observation in this field is that highly skilled workers, and especially those with higher levels of educational attainment, are more likely to use computers in their jobs (Krueger, 1993). These facts have led to the important consensus in the labour economics literature that a burst of new technology causes a rise in the demand for highly skilled workers, which in turn implies an increase in the wages of skilled workers relative to unskilled workers. This hypothesis is known as the Skill-Biased Technological Change (Acemoglu, 2002; Acemoglu, 1998).

In this sense, some research (Berndt *et al.*, 1992; Berman *et al.*, 1994; Kaiser, 2000) shows that, over the last few decades, this has been during a structural shift towards the increase in deployment of white-collar work in most sectors of developed economies and a rise in employment of workers with high levels of formal education. Moreover, other studies (Wolff, 2000; Autor *et al.*, 2001) have found that the changing in employment patterns resulted in an upgrading of cognitive and interactive skills and a decreasing demand for manual skills. This evidence is simultaneous with the increase of ICT investment and extent to which firms adopt ICT. The link between ICT and the demand for high-skilled labour is due to the fact that the introduction of digital technologies alters the skill requirements of occupations in three main ways (Spitz, 2003): 1) ICT capital substitutes repetitive manual and repeti-

tive cognitive activities, 2) ICT capital is complementary to analytic and interactive activities, and 3) ICT capital increases the requirement for computing skills. This relationship underlies the evidence that, compared to previous technological revolutions (that aimed to routinize manual tasks), digital technologies are also capable of taking over simple human cognition tasks such as perceiving, choosing and manipulating processes, and searching and managing information; and in addition computer technologies are complementary to analytical and interactive activities. There is also evidence that ICT capital does not substitute whole occupations, but that it is limited to some tasks. This limited substitution relationship, pointed out by Bresnahan (1999) shifts the demand for labour towards workers with higher levels of education who are considered to have a comparative advantage in performing analytical and interactive tasks. Thus, computer technologies shift the relative skills requirements of occupations towards analytical and interactive activities.

From the private benefits point of view, and following human capital theory approach, the increase of individuals' level of educational attainment is consistent with an increase of their productivity in the labour market, which explains higher wages for more educated workers.

Moreover, there is a relation between the labour market experience, major education attainment and higher earnings. As we can see in the table below, 10 years of experience in the labour market increase real earnings by approximately 16% for employees with less than upper secondary education, 30% for employees with upper secondary education and 40% for employees with tertiary education. These data make it evident that earnings grow with experience significantly faster for the more educated employees than for the less educated.

To determine differences in wages between individuals that have followed higher education programmes through online methodology it is useful to test how occupational skill requirements and the degree of ICT adoption by industry matches online students' skills.

In order to do this, it is necessary to assume an implicit relationship between education and ability (Griliches and Mason, 1972), recognizing the fact that online students may acquire specific skills. In particular, it is assumed that online students should attain higher computing skills and more abilities related to ICT use, such as knowledge transmission by digital devices, information management, self-programming and continuous learning abilities (Levin *et al.*, 1987).

Data from Spitz's work *IT Capital, Job Content and Educational Attainment* (2003) allow us to see some changes, and

new trends in the skills requirement along the period from 1979 to 1999. The data describe an increase in the average proportion of interactive skills in the work of all occupational categories (all the occupational groups increase the interactive tasks more than 50 %). Furthermore, professional, tech-

nical and clerical workers realize less analytic tasks than in 1979 in contrast to production operatives and craft workers who carry out more analytic tasks in their occupations. This trend may be partially due to the increase in education for the production operatives and craft workers.

TABLE 3. Trends in aggregate skills requirements (workers between 15-65 years old in West Germany and of German nationality)

	Analytic skills	Interactive skills	Repetitive cognitive	Repetitive manual	Non-repetitive manual skills	Computer skills
1979	12.8	11.5	15.2	10.9	49.2	0.3
1985/86	10.0	23.8	16.7	18.8	27.9	2.8
1991/92	8.3	23.6	15.3	11.4	36.1	5.3
1998/99	15.2	63.7	3.0	2.1	11.0	5.0

Source: Spitz (2003)

The repetitive and the non-repetitive manual skills requirements decreased significantly over the two decades in all the occupational groups, even among the operatives and craft workers. There was a progressive

increase in pc-skills requirement in all the occupational groups during this the period. Clerical workers are the occupational group that use their pc-skills more intensively..

TABLE 4. Distribution of task intensities by educational groups (workers between 15-65 years old in West Germany and of German Nationality)

	Analytic skills	Interactive skills	Repetitive cognitive	Repetitive manual	Non-repetitive manual skills	Computer skills
High level of education	19.1	53.6	12.1	2.0	8.3	5.0
Medium level of education	11.4	28.4	13.3	10.9	32.5	3.4
Low level of education	8.0	23.2	10.0	15.9	41.4	1.5

Source: Spitz (2003)

## 5. E-learning skills and productivity: the case of UOC's degree students

Within the Skill-Biased Technological Change framework, we aim to verify two interesting points:

- Experience, understood as production losses avoided, is a critical factor in explaining wage improvement for online graduates.
- ICT skills have a positive and significant effect on labour productivity (wages) as firms value the interactive and analytical abilities beyond ICT uses at the place of work.

According to the theoretical framework, it is feasible to identify some critical sets of variables in the explanation of online degree students' wages. We have divided these variables into three categories:

1. The usual variables in wage analysis, based on individual's traits (sex, age, parenthood and economic position at home) and on schooling.

2. An additional set of variables based on the individual's position at work: the kind of job and the existence of flexitime at work.

3. Some variables reflecting individual's ICT skills and professional-ICT based skills.

TABLE 5. Dependent, independent and control variables in Mincerian regressions

Dependent variable	Measures	Characteristics
<i>Individual earnings</i>		
Wages	Gross annual earnings in current euros	Numerical
Explanatory variables	Measures	Characteristics
<i>Individual characteristics, Schooling, Experience, Labour relations, Labour category, Professional skills, ICT skills</i>		
Sex	1 = Male 2 = Female	Binary
Age	Age at time of graduation	Numerical
Children	Having children Number of children	Binary Numerical
Economic position at home	Main income provider = 1 Not main income provider = 0	Binary
Schooling	Number of years studying before starting at UOC	Numerical
Experience	Number of years holding a job	Numerical
Kind of work	Entrepreneur = 1 Worker = 0	Binary
Flexitime at work	Full time worker = 1 Part time worker = 0	Binary
Professional ICT-based skills	Technical knowledge, continuous learning, self-programming, time management, decision making, adaptability, communication, networking	Numerical (1,10)
ICT skills	Computers, software, Internet, data bases, Virtual communication channels	Numerical (1,10)
Control variables	Measures	Characteristics
<i>Place living, Economic sector, Undergraduate programme, Motivation of education, ICT in industries</i>		
Place living	Barcelona = 1 Others = 0	Dummy
Economic sector	Private sector = 1 Public sector = 0	Dummy
Job categories	Managers = 1 Others = 0	Dummy
Type of labour contract	Fix = 1 Temporary = 0	Dummy
Kind of undergraduate programme	Economics, Computer Engineering, Laws = 1 Others = 0	Dummy
Motivation of education decision	Improve at work = 1 Others = 0	Dummy
ICT in industries	ICT users = 1 Not users = 0	Dummy

Source: authors

We also used a database of degree students from the UOC which has information on individuals' wages and skills, obtained through a survey conducted in 2005.

TABLE 6. Sample of UOC's degree students

Undergraduate programme	Number of students
Business	544
Psychopedagogy	535
Laws	110
Computer Management Engineering	99
Computer Systems Engineering	135
Business Administration	424
Librarian Studies	294
Philosophy	83
<b>Total sample</b>	<b>2,224</b>

Source: authors

We have used Mincerian wage functions to analyse the relationship between wages and the abovementioned set of explanatory variables. The results from the analysis show that all the variables used in our model have a positive and significant relation with degree students' wages, except schooling and professional ICT-based skills. Moreover, we can also confirm that the explanatory variables we have computed are useful to explain more than 60% of the differences in wages of degree students.

Our results show some interesting features:

- First of all, it is very important to comment that schooling, in which studies at UOC are included, is not a significant variable to explain the level of wages for degree students after their investment in education.
- A second result that should be highlighted is that experience, understood as previous productivity and production losses avoided, is the most important variable explaining wages improvement for online degree students.
- A third notable result is that we have been able to demonstrate that the more ICT skills are developed in individuals, the more likelihood there is of increasing labour productivity, measured through wages. We have also found that soft skills related to ICT uses (technical knowledge, continuous learning, self-programming, time management, decision making, adaptability, communication, networking) do not have a significant effect on wages improvement, showing a gap between workers skills and labour needs in Catalan industries.
- In addition, we can affirm that there are some individual characteristics that have a positive and significant impact in the explanation of wage differentials: married men who are the main income providers are more likely to have higher wages than the rest of the sample.
- Finally, from the labour market point of view, entrepreneurs have higher returns than workers, and within this last category full-time workers in the private sector receive higher wages than workers in the public sector or part-time workers.

TABLE 7. Results. Wage analysis

Dependent variable: Wages after graduation

Method: Least squares

Included observations: 543

Variable	Coefficient	Std. error	T-statistic	Prob.
C	9.135596	0.110561	82.62944	0.0000
Sex	0.655371	0.027767	2.354242	0.0189
Civil status	0.094512	0.027396	3.449860	0.0006
Flexibility at work	0.312414	0.059494	5.251183	0.0000
Economic sector	0.087368	0.027110	3.222749	0.0013
Economic position home	0.125698	0.027681	4.541004	0.0000
Wages before graduation	2.05E-05	1.08E-06	19.00719	0.0000
Experience	0.019895	0.007084	2.808414	0.0052
Kind of work	0.88011	0.042752	2.058619	0.0400
Schooling	0.025385	0.070988	0.357592	0.7208
ICT skills	0.004042	0.001849	-2.186302	0.0292
Professional ICT skills 1	-0.017371	0.009939	-1.747742	0.0811
Professional ICT skills 2	0.005144	0.003835	1.341185	0.1804
Professional ICT skills 3	-0.005353	0.006578	-0.813769	0.4161
Motivation	0.099511	0.026550	3.748021	0.0002
R-squared	0.609250	Mean dependent var.		10.21674
Adjusted R-squared	0.598889	S.D. dependent var.		0.431083
S.E. of regression	0.273019	Akaike info criterion		0.268685
Sum squared resid	39.35681	Schwarz criterion		0.387390
Log likelihood	-57.94810	F-statistic		58.80333
Durbin-Watson stat	2.061097	Prob. (F-statistic)		0.000000

Source: authors

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## Recommended citation

CASTILLO, DAVID; VILASECA, JORDI; SERRADELL, ENRIC; VALLS, NATÀLIA (2008). "E-learning and Labour Market: Wage-premium Analysis". In: "The Economics of E-learning" [online monograph]. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 5, no. 1. UOC. [Accessed: dd/mm/yy].  
<[http://www.uoc.edu/rusc/5/1/dt/eng/castillo\\_vilaseca\\_serradell\\_valls.pdf](http://www.uoc.edu/rusc/5/1/dt/eng/castillo_vilaseca_serradell_valls.pdf)>  
ISSN 1698-580X



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## About the authors

*David Castillo-Merino*

Assistant Lecturer at the Department of Economics and Business of the UOC.  
[dcastillo@uoc.edu](mailto:dcastillo@uoc.edu)

Dr. David Castillo-Merino holds a position as Assistant Professor at the Department of Economics and Business of the UOC. He is a member of the *New Economy Observatory* (IN<sub>3</sub>-UOC) research group. He is director of Masters in the field of Corporate Finance. His research interests and areas of expertise include: the economics of intangible assets, finance and innovation in firms, and e-learning and is an author of books and papers in these areas. He participates in the European eLene-EE project on the economics of e-learning.<sup>[www1]</sup>

*Jordi Vilaseca-Requena, PhD*

Lecturer at the Department of Economics and Business of the UOC.

Dr. Jordi Vilaseca-Requena holds a position as Professor at the Department of Economics and Business of the UOC. He is director of the *New Economy Observatory* (IN<sub>3</sub>-UOC) research group. His research interests are focused on the knowledge economy, a field in which he has written several books and papers. He participates in the European eLene-EE project on the economics of e-learning.<sup>[www1]</sup>

*Enric Serradell-López*

Assistant Lecturer at the Department of Economics and Business of the UOC.  
[eserradell@uoc.edu](mailto:eserradell@uoc.edu)

Prof. Enric Serradell-López holds a position as Assistant Professor at the Department of Economics and Business of the UOC. He is co-director of Masters courses in the field of Corporate Finance. His research interests and areas of expertise include: corporate culture, the economics of intangible assets and e-learning. He participates in the European eLene-EE project on the economics of e-learning.<sup>[www1]</sup>

*Natàlia Valls-Ruiz*

Assistant Professor at the Department of Economics of the University of Barcelona (UB).

Prof. Natàlia Valls-Ruiz is a financial analyst. She is also Assistant Professor at the Department of Economics of the University of Barcelona (UB) and research assistant of the *New Economy Observatory* (IN<sub>3</sub>-UOC) research group.

[www1] <http://www.elene-ee.net/>

## Monograph "The Economics of E-learning"

## ARTICLE

# Do Online Students Perform Better than Face-to-face Students?

## Reflections and a Short Review of some Empirical Findings

*Johan Lundberg*  
*David Castillo-Merino*  
*Mounir Dahmani*

Submitted: February 2008

Accepted: February 2008

Published: April 2008

### Abstract

The increases in the number of online courses given by universities have been quite dramatic over the last couple of years. Nowadays, many universities even give complete degree programs online where instructions and lectures in the form of, for example, streaming videos, are available for students to watch 24 hours a day. In a sense, the use of Internet and Interactive Computer Technologies (ICT) in higher education can be compared to any other type of teaching tool, such as the blackboard and overhead projectors. The motivation for using the Internet and ICT in higher education, from an economic point of view, is if they are more effective as teaching tools compared to any relevant alternative. That is, all else being equal, if the Internet is an effective teaching tool in that students who attend online courses or complete degree programs perform better in terms of marks in the final exam compared to face-to-face students. In this paper we reflect on and summarize some of the empirical findings in the literature on the effects of online teaching on student performance compared to face-to-face equivalents.

### Keywords

literature review, efficiency in higher education, student performance, ICT uses

*¿Obtienen mejores resultados los estudiantes que siguen cursos por Internet que los que siguen cursos presenciales? Reflexiones y breve revisión de algunos resultados empíricos*

### Resumen

*El aumento del número de cursos en línea impartidos por las universidades ha sido espectacular en los dos últimos años. Hoy en día, muchas universidades ofrecen incluso programas de titulación completa por Internet. Los estudiantes cuentan con acceso 24 horas a las instrucciones y los contenidos de las clases, p. ej., en formato de vídeo. En cierto modo, el uso de las*

*TIC en la educación superior puede compararse con cualquier otro tipo de herramienta aplicada a la enseñanza, como la pizarra o el proyector de transparencias. El argumento a favor del uso de Internet y las TIC en la educación superior, desde un punto de vista económico, es que son más eficaces como herramientas aplicadas a la enseñanza en comparación con cualquier otra alternativa relevante. Es decir, Internet será una herramienta de enseñanza eficaz si, en igualdad de condiciones, los estudiantes que siguen cursos o programas de titulación completa impartidos por Internet obtienen mejores resultados en términos de calificaciones en los exámenes finales que los estudiantes que siguen cursos presenciales. En este estudio comentamos y resumimos algunos de los resultados empíricos disponibles en los estudios publicados acerca de los efectos de la enseñanza en línea sobre el rendimiento de los estudiantes respecto a los estudiantes que siguen cursos presenciales.*

### **Palabras clave**

*revisión de estudios publicados, eficacia en la educación superior, rendimiento de los estudiantes, usos de TIC*

## **1. Introduction**

The Internet is about to cause a minor revolution within the, in many other respects, conservative world of higher education. Not only has the Internet for some students outperformed university libraries as the main source for information and facts, it is also challenging face-to-face lectures as a teaching tool. Today, stand alone online courses and complete degree programs are offered via the Internet by many universities. Also virtual universities have appeared, giving entire courses over the Internet, with some of them not even having a campus and therefore no on-campus students. The progress in this direction is going fast and it is probably not possible, or even desirable, to stop. However, it is sometimes wise to reflect, just for a moment or two, on the increased supply of online courses in higher education. What are the pros and cons of this development?

One of the advantages of online courses is the fact that it is now possible to reach students who otherwise would not, for different reasons, have undertaken university studies. This could be due to practical reasons such as their family situation not allowing them to move to a university town. Or the individual might prefer to attend an online course or a complete online based degree program as online courses in many cases offer more flexible study hours. For example, a student who has a job could attend the virtual class watching instruction films and streaming videos of lectures after working hours, whenever they are. Hence, online courses make it possible for students to live far from campus. Whatever the reason, if online courses attract students who otherwise would not have attended higher education, this is of importance from a policy perspective as it has a positive effect on the accumulation of human capital.

Other potential pros of online courses relative to campus equivalents relate to the other actors, the providers

of higher education. From the universities' point of view, online courses could be more cost-effective compared to campus courses if it means that the university can teach more students using the same or less resources compared with an equivalent campus based course. For instance, if the teacher can re-use materials such as streaming videos of lectures several times it could decrease the teacher's time for preparation and realisation of the course the next time the same course is given, meaning that both teachers and universities save resources. However, in a study based on nearly 4,000 students enrolled on introductory economics at universities in the USA, Sosin *et al.* (2004) come to the conclusion that there was no significant difference in time spent between teachers who use a large amount of Interactive Computer Technology (ICT) in their teaching and those who use none or only a small amount.

Moreover, the use of Internet and ICT in higher education could be a good pedagogical tool and hence save time and resources for both students and teachers. In other words, other things being equal, it could be that, for every hour spent studying, a student who attends an online course learns more than a student who takes the same course as an ordinary, face-to-face, campus course. This would not only save teachers' time and university resources through the decreased number of re-examinations, but also student's time.

What are the cons? All the pros of online courses could of course be cons: if these courses do not tend to attract more students (including students who would otherwise not have undertaken a university education); if the preparation and realisation of the courses tend to consume more resources than an ordinary campus course, etc. Even if not all the pros are turned into cons, it might be the case that the cons outweigh the pros, or vice-versa. Again, whatever the result of such an evaluation, the final result is of interest to policy makers as it would suggest whether online education should or should not be encouraged.

The objective of this paper is not to validate all pros and cons of online teaching in higher education and to come up with the answer to whether online teaching, is from an economic perspective, good or bad. Instead, we have a narrower perspective in that the main purpose of this paper is to reflect on and summarise some of the existing empirical knowledge regarding the most important determinants of student success in university courses. In particular, we will focus on the question of whether students who attend an online-based course, where the Internet and ICT are used to a high degree as a teaching tool, tend to perform better or worse compared to students who attend ordinary, face-to-face and campus based courses, where the Internet and ICT are used to a low degree, or not at all. The reflections and reviews in this paper focus on studies based on quantitative analysis and regression models, preferably multiple regression analysis. We will also try to distinguish between different subjects. That is, is there any evidence suggesting that online teaching and the use of Internet and ICT is better suited for some courses or subjects than others?

As this literature is quite extensive, we do not claim or suggest that our review covers all existing papers within this field but instead we will summarize what we believe to be the some of the most interesting findings. And even though we focus on university courses, the overall discussions regarding the use of Internet and ICT as teaching tools could to some extent also apply to other situations.

In what follows, online course or online education will be used as a comprehensive term for Internet education and the use of ICT in higher education. In the same manner, face-to-face education will be used for traditional campus courses. The rest of this paper is organised as follows. In section 2 we discuss some methodological issues that are of importance in the analysis of student performance. These include different measures of student performance, other potentially important determinants of student performance and whether the course is given online or on campus. This section also includes a short comment on some econometric issues. Some empirical results are presented and discussed in section 3, and the conclusions are in section 4.

## 2. Methodological issues

### 2.1. How to measure student performance

One of the more fundamental questions in analysing the effect of a specific teaching tool on student performance is

to define the concept of student performance. How should it be measured? In the economics literature, student performance is often measured as the student's mark in a written test at the end of the course. In many cases, this mark is only reported as *pass* or *fail* where *fail* corresponds to a mark below the previously set level for *pass*. Even though, in some cases, students are only interested in whether they have failed or passed (or passed with distinction, a grade often reported), which is also the information given in the final certificate, this is a rather crude measure of student performance, as the researcher can not distinguish between students who have high marks and students who only just pass. A more sophisticated analysis is of course possible if the researcher can get access to the precise test score, which will give them more information (see, among others Brown and Liedholm, 2002). However, one important issue when using test scores is that the researcher usually does not have any information regarding the extent to which the test actually reflects the contents of the course.

Independent of which of these measures is used to capture student performance (test scores or fail/pass), one potential problem is that the researcher often does not have information regarding the student's previous knowledge. Therefore, by only using test scores, the researcher does not have any information on whether the student has gained any knowledge during the course but only what level the student has (or does not have) at the end of the course. This problem could be overcome if student performance is measured as the difference between the student's previous knowledge and that at the end of the course, although there are difficulties in collating this information. One relates to the design of the pre-course test in relation to the post-course test (the final exam) as it would be problematic to use exactly the same questions in both tests.

Another difficulty is that students may have objectives other than just high scores in the written test. They might just want to sit in during the lectures to enjoy the atmosphere, to socialise with friends who attend the same course and lectures, or might be happy just to have been accepted on the course. It could also be the case that the student is applying for a job and taking a course rather than being unemployed, as being a student might look better for potential employers. In this situation, the student might actually not be interested in learning anything and hence not pay attention, no matter what teaching tool is used. If there are a number of students who are predetermined to fail the final exam due to the reasons stated above, and this is not controlled or corrected for in the empirical analysis, this could give biased and inconsistent parameter estimates which, in turn, could generate misleading conclusions.

When it comes to comparisons of student performance across subjects and courses it is important to consider that the form of the final exam sometimes differs between subjects, and even across courses in the same subject. For instance, introductory courses on economics are most typically examined through written exams at the end of the course, while a combination of lab-reports and written tests is frequently used in chemistry and electronics. Oral examinations are sometimes used in linguistic courses, etc. However, despite these drawbacks and difficulties, student performance is most often measured in terms of grades or marks in different tests during the course. One reason for this is that this information is relatively easy to get hold of. At the end of the course each teacher is, in most cases, obliged to report whether students have failed or passed. It is important to be aware of the weaknesses of the measures of student performance frequently used when reading the literature.

## 2.2. Other potentially important factors for student success

The literature on the effects of online education on student performance is closely related to the more general literature on important determinants of student success. In a sense, online teaching could be seen as just another teaching tool, and could actually be compared to the use of the more traditional blackboard. For instance, if the use of the blackboard does not contribute to the student's ability to understand and assimilate the information provided by the teacher, then the use of the blackboard should be questioned. The same goes for the use of the Internet and online teaching in higher education.

Hence, before we proceed and discuss the main issue of this paper – the effects of online teaching on student performance – let us discuss some other potentially important determinants of student performance used in the literature. One of the reasons for doing this is to highlight the fact that there are other factors likely to affect student performance besides whether the student attends an online or face-to-face course. We will not cover all these factors, nor will we discuss their measurability – that would be beyond the scope of this paper – but just highlight that there are other factors that matter for student success apart from the course being online or at campus. However, the issue is of importance from many perspectives, and maybe most so from an econometric point of view, as the failure to include relevant variables in the model could lead to biased and

inconsistent parameter estimates. In the end, this would cause misinterpretations of the parameter estimates and their corresponding significance.

Firstly, in online courses, the Internet and ICT are used as a substitute for the ordinary face-to-face teaching technique. However, if face-to-face teaching does not contribute to the learning of the students, then online teaching and the use of Internet and ICT in higher education is compared with something that does not contribute to the learning of the students.

When it comes to student attendance in class and their performance, the results are ambiguous. For instance, controlling for student motivation, an issue we will return to later on, Romer (1993) found that attendance did contribute to the academic performance of the students on a macroeconomics course he taught in the autumn of 1990. Similar results had previously been found for courses on macroeconomics by Schmidt (1983) and also by Park and Kerr (1990) for a money and banking course. These results were later verified by, among others, Durden and Ellis (1995).

However, contrary to these results, Brown *et al.* (1991) did not find any evidence that a student who attended typically structured classes with lectures performed better on the Test of Understanding College Economics (TUCE) compared to students who attended a standard microeconomics principles course. What they did find was that students who attended the lectures performed better on essay questions than those who did not. In an early paper, McConnell and Lamphear (1969) found no significant difference in performance of students with and without classroom attendance.

Motivation is often considered to be one of the most important driving forces for people to reach their goals. Some argue that motivation actually out-competes talent when it comes to sports activities: It does not matter how talented you are, if you do not have the right motivation, you are deemed to be second. Even though this might be the case, motivation is quite difficult to measure. It could be reflected by the number of training hours (or, in our case, the number of hours spent studying and/or in class), but this is not necessarily a good measure. For instance, a student could attend class because of being raised to be a dutiful person, but not pay attention to what the teacher has to say in class. Another possibility is to ask the students how motivated they are. One problem with this method is, of course, that the results will be highly subjective. Romer (1993) used the number of non-compulsory problem sets the student did during the course as a proxy for motivation: the more non-compulsory problems sets, the more moti-

vated the student. Even though this is probably a reasonably good measure of motivation, it does still suffer from the same drawbacks as the number of hours in class. The argument has also been made that innovations in the use of technology in higher education, such as the use of ICT, actually could have a positive effect on motivation, attitude and student performance (see Talley, 2005).

Student motivation and attendance relate to the factor, often quoted in the literature, of how much time and concentration the student dedicates to other activities. Durden and Ellis (1995) find a negative yet insignificant effect of jobs on the side. Other studies have also used measures of the number of hours spent on activities such as sports and social activities. The effect of physical training could go either way, depending on how much time the student spends on such activities. It could be argued that physical exercise improves your ability to concentrate and should therefore have a positive effect on student performance. On the other hand, the undertaking of too much physical exercise will have a negative effect on the available time for studies, as a day only has 24 hours, and it might also require spending time on recovery and rest between training sessions.

As mentioned in the discussion of different definitions of student performance, it is reasonable to assume that the student's previous knowledge will affect their ability to pass the final exam. Pre-knowledge is typically measured as previous college grades or previous experience in higher education. For instance, Park and Kerr (1990), Anderson *et al.* (1994), and Durden and Ellis (1995) find high pre-university grades to have a positive effect on student performance. Roamer (1993) and Coates *et al.* (2004) find the same positive effect of previous experience from university studies on student performance.

Two other variables frequently used in this type of studies are age (Anderson *et al.*, 1994, and Coates *et al.*, 2004) and gender (see Durden and Ellis, 1995, and Coates *et al.*, 2004, just to name two). It could be argued that age reflects maturity and hence should have a positive effect on performance, but it is also reasonable to assume that the ability to learn new things decreases with age. Anderson *et al.* (1994) found a negative, decreasing effect of age on student performance, while Coates *et al.* (2004) found no effect at all. The effect of gender is rather difficult to interpret as it is not reasonable to believe that, for instance, men are more intelligent than women. Instead, gender is likely to capture differences in how we are brought up and other social factors. Such effects are probably also reflected by the different measures of race used in the literature (see Brown and Liedholm, 2002, and Coates *et al.*, 2004).

Like students, teachers differ in several respects such as personality, talent, and pedagogical skills, factors that are likely to affect student performance, motivation, and attitude. In many studies on the effects of online teaching on student performance, the same teacher is teaching both the online and the face-to-face course, which should mean that the teacher's contribution to each individual student's attitude, motivation and performance is kept constant. However, the very same teacher may actually perform and act differently in different environments. For instance, the teacher could be inexperienced in use of the Internet and ICT which could have a significant effect on the ability to contribute to the student's learning.

Navarro (2000) addressed the issue of teacher performance in online versus face-to-face situations. Based on interviews, formal discussions and questionnaires to more than 100 teachers and instructors, Navarro comes to the conclusion that a large majority of the teachers believed that they performed similarly or better in the online environment. If one believes that older students are more motivated, a possible explanation for this result is that the average age of the online students in this study was higher than that of the face-to-face students. Navarro also found that more motivated teachers tend to use ICT and new teaching techniques to a larger extent than less motivated teachers. Teachers also differ in their attitudes towards adopting and introducing new teaching methods. For instance, from a survey among academic members of the American Economic Association (AEA) and teachers listed in the College Marketing Guide (CMG), Becker and Watts (2001) conclude that teachers in economics are quite reluctant to adopt new teaching methods. One explanation put forward by the authors is that the introduction of new teaching techniques and ICT is associated with a sunk cost, a cost that economics teachers are not willing to accept. The results presented by Navarro (2000) support the idea that the development of traditional face-to-face lectures is more cost effective (less time consuming) for teachers compared to online lectures.

There are of course also other student characteristics and factors that could have a significant impact on their performance, such as their family situation (for instance the number of children), mental health status, etc. In a study on the influence of different learning style preferences on student success in online versus face-to-face environments, Aragon *et al.* (2002) found that students can learn equally well in either format, regardless of learning style, provided that the course is developed around adult learning theory using good instructional design guidelines. Unfortunately, they do not make any formal analysis of significant differ-

ences between online and face-to-face courses. The results presented in the paper do not indicate that one learning style has a significantly larger impact on, for instance, the performance of online students as compared to face-to-face students. However, that issue was beyond the scope of their paper.

### 2.3. A short comment on some econometric issues

The failure to use appropriate econometric tools and estimators in empirical analyses of phenomena such as student performance could result in biased and inconsistent estimates, possibly leading to misleading inferences and, eventually, misinterpretation of the results. There are at least three econometric issues that need special attention. The first is that of the factors that are regarded the most important determinants for student success, one that is considered to be endogenous, namely effort or the time the student spends on studying. If, for instance, a student's goal is only to pass the course, and a new, very effective teaching tool is introduced, the student could actually spend less time studying and still reach their goal.

Consequently, the time the students spend on studying is not determined outside the model and therefore the econometric analysis should include instrumental variables. Even though the use of instrumental variables is now standard in econometric software, the technique is nearly exclusively used by economists.

The second issue relates to self-selection. That is, it could actually be the case that a specific type of student who tends to perform better than other students chooses either campus or online courses. Coates *et al.* (2004) find that failure to account for self-selection of students either in face-to-face or online courses could lead to misinterpretation of the results. Their solution to the problem of self-selection was the use of an endogenous switching regression model. However, self-selection is only occasionally discussed and corrected for in the literature.

Becker *et al.* (1996) provide evidence that students with higher levels of previous knowledge in the subject tend to be more likely to continue on the course than those with lower levels. In other words, those students who are less likely to pass the final exam tend to drop-out before they do it, which

means that there is a group of students who actually would have failed the exam but are not included in the sample. Other reasons are that students realise that they have chosen the "wrong" course and/or that they have other interests. If this is not accounted for in the empirical specification, it could lead to an upward bias of the parameter estimates.

On the other hand, it is reasonable to assume that some students never complete their studies because they get job offers before the final exam. In contrast to the other reasons for dropping out, these students have a higher probability of passing the final exam and a failure to control for this type of drop-outs will result in a downward bias of the estimated parameters.

## 3. Some empirical results

So what does the literature tell us? The results presented in a study by Brown and Liedholm (2002) based on 710 macroeconomics students in the USA suggest that campus students tend to perform better compared to online students. Brown and Liedholm used test scores as the dependent variable and also control for gender, the students' pre-knowledge in mathematics,<sup>1</sup> and their high-school grades. However, they do not control for factors such as the degree to which the students attend class, if they work, if they are engaged in other activities in their spare time, motivation, age, or self-selection. Other important characteristics of the students and their backgrounds are also lacking, Brown and Liedholm's results are supported by the findings by Coates *et al.* (2004), who base their findings on 126 macroeconomics students in the USA. In contrast to Brown and Liedholm, these authors controlled for the students' age which could reflect motivation if we consider that older students are more focused. They also controlled for how much the students work besides their studies and use an endogenous switching regression model to correct for self-selection.

Even though previous results based on economics students suggest that campus students tend to perform better compared with online students, these results are by no means general for all courses and subjects. It is not even a general result when it comes to economics. For instance, Sosin *et al.* (2004) find the use of technological tools in teaching economics at the introductory level to have a positive effect on student performance. These results are

1. Good pre-knowledge in mathematics is often considered to be an important variable when it comes to learning economics. This is partly confirmed by the results presented in Brown and Liedholm (2002) as their results suggest pre-knowledge in mathematics have a positive effect on the performance of campus students. However, no such effect was found for online students.

based on a quite extensive data set of nearly 4,000 students taught by 30 instructors across 15 different departments. However, all these students attended campus courses, even though the technological tools differ between the different courses. Therefore, these results are not comparable with other results presented in this review.

In another study on 345 computer science students, Dutton *et al.* (2002) found online students perform significantly better compared to their peers who take the campus version of the same course. One tempting explanation for this difference between economics and computer science students is that those interested in computers tend to choose computer science instead of economics, and if so, this result is driven by self-selection. Dutton *et al.* also found that students who take the online version of the course tend to be older, are to a lower extent enrolled in traditional undergraduate programs, are more likely to have jobs and children and tend to live further away from campus as compared to face-to-face students. Hence, the online students have a greater need for flexible studying hours. Among the students included in this study, face-to-face students value the ability to get advice from the lecturer as an important factor for choosing the face-to-face version of the course. Moreover, the proportion of drop-outs is higher within the group of online students. Although this study provides many interesting results, the potential problem of self-selection between the online and face-to-face courses is not addressed, nor is the endogeneity of study time and the fact that the proportion of drop-outs is higher among those who choose the online version of the course. The potential problem of self-selection can probably not be ignored as the authors find prior computer experience to have a positive impact on the performance of online students, and when this is controlled for in the model, the significant difference in performance between online and face-to-face students is reduced.

Hoskins and van Hoff (2005) analysed the effects of the dialogue method via an online environment on student performance among 110 undergraduate psychology students. They find the dialogue method to have a positive effect on student performance. Again, however, the potential problem of self-selection is not properly addressed. As the authors point out, the students who seize the opportunity to take part in this dialogue method tend to be more motivated, and this group also differs from others when it comes to age and gender. These factors, together with the fact that they base their conclusions on differences in mean values between this group of students and the rest, make it difficult to compare these results with other results based on multiple regression analysis where it is possible to control for a number of different student characteristics.

Analysing student performance of 62 management students in the USA, Neuhauser (2002) finds no significant difference in the mean value of test scores for online versus face-to-face students. The potential problem of self-selection is discussed but not controlled for. And even though the author has information on gender, age, effectiveness of tasks and course effectiveness, this information is not controlled for in the empirical analysis. Instead, only mean values of the different characteristics of the separate groups are compared.

#### 4. Final reflections

Analyses of the dramatic increase in the number of online courses offered at universities are of importance from many perspectives. One relates to the potential of online education to attract new groups of students who would otherwise not have undertaken university studies. If online courses attract these groups of students this is of importance as it will have an effect on the accumulation and distribution of human capital. Another important issue is the effect on student performance. If, all else being equal, students who attend online courses tend to perform better compared to face-to-face students, this is an argument for substituting face-to-face teaching for online teaching techniques for campus students as well.

The main conclusion from this literature review is that there is no general support of the hypothesis that online students should perform better compared to face-to-face students. Some studies, especially those based on economics students report the opposite result. Other studies report results that support the hypothesis. This disparity in the results of the studies can partly be explained by the fact that the methodologies differ, making them non-comparable. Another possible explanation is that in the papers reviewed here, as well as in most papers reviewed elsewhere, online teaching and face-to-face lectures are treated as a homogeneous good, making no distinction regarding how the Internet and ICT are used as teaching tools. Instead, online teaching is assumed to be used in the same way independently of teachers, their characteristics and teaching methods. To return to the comparison with the blackboard made earlier in this paper, it would be the same as saying it does not matter how you use the blackboard or what you write on it during the lectures as long as you use it!

Although the papers presented in this review reveal many interesting and important insights, the challenge for future research is to combine the main contribu-

tions from each of these studies. As in all quantitative empirical research within the social sciences, data collection and the use of appropriate statistical methods are crucial ingredients. For future research, we suggest the following procedure: i) Collect data from many courses and subjects. The number of students within each group should be large; ii) Construct a measure which reflects the knowledge gained during the course. This could be based on the difference between the student's pre-knowledge and final test scores; iii) Include all relevant explanatory variables such as motivation, time spent in lectures, time spent on other activities, which could either distract the student from studies or have a positive effect on the ability to concentrate, as well as motivation, family situation, age, and gender. All student characteristics could be collected through the use of a student diary where the student reports all these activities during the course; iv) Include teacher characteristics such as the teacher's background, age, motivation, pre-skills in online and face-to-face teaching; v) Include differences in teaching methods used by the individual teachers; vi) Use appropriate estimators in order to minimise potential bias and inconsistency in the estimators; vii) Use instrumental variables to handle the endogeneity of study time; viii) Correct for self-selection; ix) Analyse and correct for drop-outs in order to evaluate to what extent the drop-outs affect the parameter estimates.

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### Recommended citation

LUNDBERG, JOHAN; CASTILLO, DAVID; DAHMANI, MOUNIR (2008). "Do Online Students Perform Better than Face-to-face Students? Reflections and a Short Review of some Empirical Findings". In: "The Economics of E-learning" [online monograph]. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 5, no. 1. UOC. [Accessed: dd/mm/yy]. <[http://www.uoc.edu/rusc/5/1/dt/eng/lundberg\\_castillo\\_dahmani.pdf](http://www.uoc.edu/rusc/5/1/dt/eng/lundberg_castillo_dahmani.pdf)>  
ISSN 1698-580X



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### About the authors

*Johan Lundberg*

Assistant Professor at the Centre for Regional Science at Umeå University  
[Johan.Lundberg@econ.umu.se](mailto:Johan.Lundberg@econ.umu.se)

Dr. Johan Lundberg holds a position as Assistant Professor at the Centre for Regional Science at Umeå University. He has a PhD in economics and works with research and education within the field of regional economics and economics of education. He participates in the European eLene-EE project on the economics of e-learning.<sup>www1</sup>

*David Castillo*

Assistant Lecturer at the Department of Economics and Business of the UOC.  
[dcastillo@uoc.edu](mailto:dcastillo@uoc.edu)

Dr. David Castillo-Merino holds a position as Assistant Professor at the Department of Economics and Business of the UOC. He is a member of the *New Economy Observatory* (IN3-UOC) research group. He is director of Masters in the field of Corporate Finance. His research interests and areas of expertise include: the economics of intangible assets, finance and innovation in firms, and e-learning and is an author of books and papers in these areas. He participates in the European eLene-EE project on the economics of e-learning.<sup>www1</sup>

[www1] <http://www.elene-ee.net/>

*Mounir Dahmani*

PhD student in Economics at the University of Paris Sud  
mounir.dahmani@gmail.com

Mounir Dahmani is a PhD student in Economics at the University of Paris Sud. He has a degree in Industrial Economics from the University of Tunis and Master's in European Markets and Firms strategies. He is currently teaching Microeconomics, Macroeconomics and organisation theory of the firm at the University of Paris Sud. In the early years of his PhD, he participated in various research projects including eLene-TT and eLene-EE European projects. The research topics covered by his PhD are: growth theory, competencies and ICT, e-learning, human capital and digital divides.

## Monograph "The Economics of E-learning"

## ARTICLE

# Describing E-learning Development in European Higher Education Institutions Using a Balanced Scorecard

*Thierry Garrot*  
*Maria Psillaki*  
*Sylvie Rochhia*

We are grateful to Adam Chmielewski, Susanna Sancassani, Florence Ducreau, Bernard Lauch, Alessandra Tomasini, Grace-Blanche Nganmini and other members of the eLene-EE work package 3

Submitted: February 2008

Accepted: February 2008

Published: April 2008

## Abstract

This paper has strong links with the European Commission's statement on the initiative "E-learning: designing tomorrow's education", adopted on 24 May 2000. It tackles the question of how Higher Education Institutions (HEI) follow the development of and manage their e-learning activities. This emerged in work package no. 3 of the eLene-EE project (Economics of e-learning, 2006-2007), which examines the economic models of e-learning.

With the help of a Balanced Scorecard (BSC), designed by e-learning practitioners, and researchers in economy and management, the e-learning development of European institutions is described over a three-year period (2004-06). The BSC shows what is prioritized and how HEI act using four main dimensions: Financial, Customers/Students, Internal Business Process and Learning/Growth. Four examples, from the universities of Lublin (on behalf of the Polish Virtual University), the Centro METID in Milan (Politecnico di Milano), and the universities of Nancy and Nice Sophia Antipolis, show different stages of development, different strategic choices and underline common aspects that could be used to design e-learning evolution models in European HEI.

Although this approach is focused on information in the HEI management field, it suggests firstly that there is a need for more research and for the elaboration of theoretical tools to conceptualize trajectories of development, and secondly, the need for BSC to be extended to all areas of HEI in order to promote coherency of student education, research, continuing education and e-learning.

## Keywords

e-learning, management, higher education, BSC, strategy, control

## *La descripción del desarrollo del e-learning en instituciones de educación superior de la Unión Europea mediante un cuadro de mando integral*

### **Resumen**

*El presente estudio está estrechamente vinculado a la declaración de la Comisión Europea sobre la iniciativa “E-learning: el diseño de la educación del mañana”, adoptada el 24 de mayo de 2000. Trata la cuestión de cómo las instituciones de educación superior gestionan y siguen el desarrollo de sus actividades de e-learning. Este tema salió a la luz en el paquete de trabajos n.º 3 del proyecto eLene-EE (La economía del e-learning 2006-2007), que examina los modelos económicos del e-learning.*

*Con la ayuda de un cuadro de mando integral, diseñado por practicantes de e-learning e investigadores en economía y gestión, se describe el desarrollo del e-learning de las instituciones europeas a lo largo de un periodo de tres años (2004-06). El cuadro de mando integral muestra a qué aspectos se da prioridad y cómo actúan las instituciones de enseñanza superior usando cuatro dimensiones principales: financiera, clientes/estudiantes, proceso empresarial interno y aprendizaje/crecimiento. Los cuatro ejemplos, de las universidades de Lublin (en nombre de la Universidad Virtual Polaca), el Centro METID de Milán (Politecnico di Milano) y las universidades de Nancy y Sophia Antipolis de Niza, muestran diferentes estadios de desarrollo, diferentes elecciones estratégicas y subrayan aspectos comunes que se podrían usar para diseñar modelos de evolución del e-learning en las instituciones de enseñanza superior europeas.*

*Aunque este análisis se centra en datos del campo de la gestión de las instituciones de enseñanza superior, indica, en primer lugar, la necesidad de seguir investigando y de desarrollar herramientas teóricas para conceptualizar las trayectorias de desarrollo y, en segundo lugar, la necesidad de ampliar el cuadro de mando integral a todas las áreas de las instituciones de enseñanza superior para promover la coherencia de la educación de los estudiantes, la investigación, la educación continua y el e-learning.*

### **Palabras clave**

*e-learning, gestión, educación superior, cuadro de mando integral (CMI), estrategia, control*

## **1. Introduction**

This paper has strong links with the European Commission's statement on the initiative “E-learning: designing tomorrow's education” adopted on 24 May 2000. This initiative, following on from the conclusions of the European Council in Lisbon, presented the principles, objectives and prospective actions related to e-learning, defined as the use of new multimedia technologies and the Internet, to improve the quality of learning and facilitate access to resources and services, such as exchanges and distance collaboration (European Community Commission, 2001). Following the study “Virtual Models of European Universities: e-learning in higher education” (elearningeuropa.info, 2004) ordered by the European Commission, eight institutions or consortia<sup>1</sup> co-operated to set up the

e-learning network “eLene”. They identified common strategic perspectives and prepared responses to the calls for proposals in the framework of the e-learning programme. eLene-EE (Economics of e-learning, 2006-2007) is the second application to a call for proposals; it considers the economic models of e-learning (OECD, 2005).

As part of this project, work package 3 (WP3) of the eLene-EE project has been looking at the management of the e-learning activities in Higher Education Institutions through the use of a balanced scorecard (BSC). This entails monitoring the changes and development of e-learning activities in universities. The three partners involved in WP3, the METID centre at the Politecnico di Milano,<sup>2</sup> the Polish Virtual University<sup>3</sup> and the CANEGE consortium are all at more or less advanced phases in the development and structuring of their mod-

1. France: CANEGE, Italy: Politecnico di Milano, Germany: University of Bremen, Netherlands: University of Utrecht, Finland: Finnish Virtual University, Spain: UOC (Universitat Oberta de Catalunya), Sweden: University of Umeå.

2. Centro METID (Metodi e Tecnologie Innovative per la Didattica) -Politecnico di Milano.

3. Marie Curie Sklodowska University in Lublin, on behalf of the Polish Virtual University.

els of learning via the Internet. They clearly need to show, within their own institutions, how their e-learning activities are progressing. The partners in the eLene-EE group collectively decided to focus the study on higher education institutions and to adopt a resolutely managerial approach. The macro-economic aspect, of interest to financiers, will be dealt with using a bottom up approach. The idea is to use a set of data gathered at each university within the region, and in neighbouring regions, and possibly neighbouring states, to verify the governing dynamics (past and present) behind the development of e-learning. This decision was taken because, with the introduction of e-learning activities, there is a lot at stake for the future of higher education institutions, and there is an apparent lack of tools to monitor the development of e-learning activities. Management, based solely on an annual budget with a balanced distribution of resources, will be insufficient to have an accurate overview in an environment where changes will inevitably accelerate. So, WP<sub>3</sub> focused its efforts on a BSC approach.

Using the BSC elaborated in the eLene-EE WP<sub>3</sub>, we describe e-learning developments in four European cases. They demonstrate different stages of development, different strategic choices and underline common aspects that could design e-learning evolution models for European HEIs. We discuss these observations within the HEI management field and in terms of future research.

## 2. Presentation of the BSC

Kaplan and Norton (1997) inspired the designing of the BSC, adapted for e-learning activities in HEI. They developed a scorecard that provides a balanced representation of the life of a company by combining the indicators from four perspectives: financial, customer, internal processes and organizational learning.

In the e-learning context, the BSC adapted the four dimensions detailed into specific indicators. The table below provides a summary:

TABLE 1: BSC of e-learning development in higher education

<b>Financial</b>
Proportion of expenditure of the establishment allocated to e-learning (general running costs, investment and maintenance of investment).
Proportion of profit generated by e-learning in relation to total profit.
<b>Customer / Student</b>
Proportion of students enrolled in e-learning/ Mixed formula/ enhanced face-to-face in relation to total numbers.
Proportion of instructors using e-learning/ Mixed formula/ enhanced face-to-face
Proportion of courses offered in e-learning/ Mixed formula/ enhanced face-to-face.
Number of complementary Internet services offered (administration, CROUS, library, leisure, etc.).
<b>Internal business processes</b>
Pedagogical matrix: Proportion of digital media available and rate of evolution per category in terms of media and tutoring offered.
Infrastructure dedicated to e-learning measured in terms of capacity and charge rate for the servers, network and staff.
Training: Proportion and average number of training hours followed by the student, administrative staff and teachers in the use of e-learning tools.
Degree of overall satisfaction with e-learning on the part of e-tool users.
<b>Learning and growth</b>
Degree of university participation in an e-learning related event (all types of communication).
Number of national or international e-learning projects organised by the university.
Number of new e-learning partnerships with public or private organisations.

The case studies in this paper give an opportunity to collect data and illustrate the use of these indicators. The way the WP<sub>3</sub> group worked was essential in this process. From a general question related to “Indicators of e-learning”,

we became involved in a practical way with academics working to link competencies and to define indicators relevant to HEI level and also to regional, state and European e-learning policy”

During the conceptual phase, we made continuing mutually agreed adjustments to the specificities of the situations of the partners and the defined objectives. We integrated dimensions relating to the quality of services provided to customers and some indicators of e-learning progression in society. We tried to identify the elements of its development. The objective of BSC was to highlight questions such as:

- How are e-learning and ICT uses progressing in our HEI?
- Have policies increased the number of e-learning students and the quality of the learning?
- What impact does the policy have on ICT use?

Adopting a bottom up approach focused on accurate data at the HEI level, the partners found it difficult to obtain the relevant data on their institutions. Over the three-year period 2004-2006, they set up one database for each year, with more than 100 basic variables collected at lower levels. In order to be as exhaustive and as flexible as possible, we chose the faculty level for our data collection. We then compiled the information at university level for each year and for each basic variable. Using these consolidated data, we were able to calculate the I1/I2 indicators and to represent them on graphs depicting their evolution in four dimensions.

The BSC is a tool for the measurement and management of performance (Radnor and Lovell, 2003) in public organizations in the field of e-learning. In this study it posed questions for universities and HEIs on several subjects. One was a definition of the usefulness of these institutions in relation to the country studied, which is not always clear; in these cases, the implementation of a tool to measure the impacts of e-learning did not appear to be a priority. The information that traditionally is available to management is rather general, whereas the methodology of the BSC requires well defined inquiries and accurate answers from the information system. This system represents the third difficulty we encountered. Sometimes, the data were required in more detail than available in the information systems, creating the need to identify and contact the person who could provide more extensive information. In many cases this was not a straightforward exercise but generally we had the co-operation of experts at the universities in seeking out the relevant data.

This situation should improve as European countries make efforts to improve the transparency of their policies and strategies. For example, in France, there is ongoing

implementation of LOLF (French Organic Law of the Financial Law), one of whose objectives is to bring together cost accounting data and qualitative information to enable the monitoring of national policies in higher education, benefiting the public interest.

In what follows we describe the BSC and e-learning development in four European universities.

### 3. E-learning development of four European universities

The most important result of the WP3 work is related to institutions. Use of the BSC allowed decision makers to understand the history of HEIs and to design a coherent plan for their future. But the set of indicators also provides information that allows us to distinguish among European HEIs. The four institutions, that participated in the eLene-EE project, presented their own case studies at the conference in Paris in December 2007, and here we summarize the main elements. We begin with the establishments that took up e-learning activities less than six years ago and continue with those that have been involved in e-learning for more than ten years *i.e.* from at least the beginning of the period studied (2004-06).

#### 3.1. Youngest institutions in terms of e-learning

##### 3.1.1. Maria Curie Sklodowska University of Lublin

As noted by Chmielewski (2007), the Maria Curie Skłodowska University (MCSU) of Lublin was established in 1944 and has been steadily expanding its programme in order to meet the changing needs and standards of a leading European HEI. About 33,000 students are currently enrolled in courses offered by ten faculties in 30 different study programmes. The university employs approximately 1,800 staff. Postgraduate and doctoral study programmes are increasingly popular.

MCSU is the most recent university in our sample to introduce e-learning, for which purpose in 2001 it created the University Centre for Distance Learning (UCZNIKO). UCZNIKO is the university department responsible for organizing and running projects that involve online education. Its objective is to prepare, organize and run projects that involve the Internet in the provision of higher educa-

tion. The first project to be launched was the Polish Virtual University (PVU).

PVU was initiated in March 2001 by UMCS in collaboration with Academy of Humanities and Economics (AHE) in Lodz and ran till February 2002. PVU's main objective was the creation and the management of distance learning courses and to this end technology was developed for the production of the courses based on the latest achievements in the ICT field. PVU set up a team of people researching the theoretical, methodological and practical aspects of distance education. One of PVU's aims was to transfer knowledge from world leaders in the field to the Polish educational system. Its main objective was two-fold: to offer programmes and courses over the Internet and to promote modern teaching methods to support

traditional lectures. So far, UCZNIKO has developed four specialties online:

- 2002/03: in marketing and management, and in computer science, at bachelor's degree level at the AHE;
- 2003/04: in political science, at bachelors level at the AHE;
- 2004/05: in administration, at masters degree level at the MCSU.

With the introduction of BSC courses period, the trends in the type of students involved in e-learning changed. The sharp increase in 2005 and 2006 is not due to MA courses alone.

C.1. People involved in university e-learning			
	2004	2005	2006
Students	1.87%	12.31%	22.08%
Others customers	0.00%	0.00%	0.00%
Lecturers	0.93%	7.99%	16.46%
Administration	5.55%	5.55%	5.55%

Number of students involved in WEL

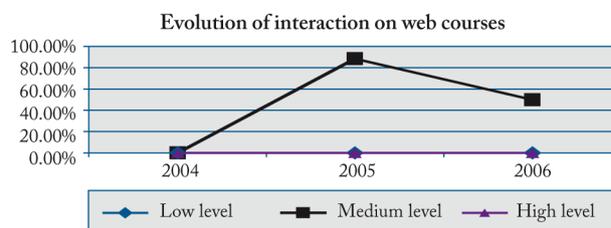
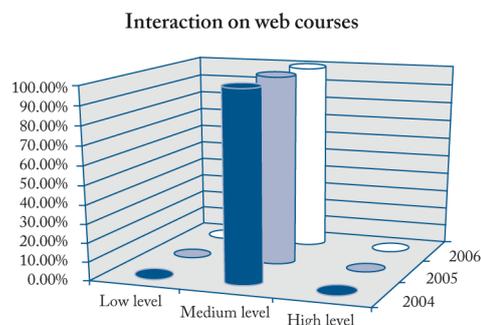
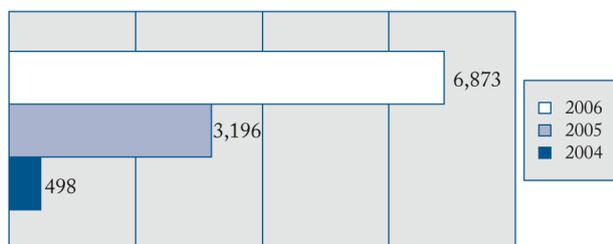


FIGURE 1: UCMS indicators for BSC courses, and data on customer and internal business process

In 2004, UCZNIKO launched its Virtual Campus project aimed at encouraging the use and incorporation of ICT by professors into traditional lectures and combining ICT use with traditional teaching methods. UCZNIKO promoted the use of ICT through this project. It also dealt with the critical question of the measurement of ICT ability in teaching and developed a system of training for professors who wanted to improve their knowledge on the distance-learning platform. Following a difficult start, the

UCZNIKO team decided that “agents of change” were needed – experts and enthusiasts in e-learning who could engender enthusiasm in others. A small group was set up and the Virtual Campus became a sort of spontaneous initiative of tutors, engaged in the project out of interest and not for any additional monetary reward. Now, in 2008, over 6,000 people are active participants in the Virtual Campus. The right hand side of figure 1 shows that this has been achieved with medium levels<sup>4</sup> of interaction and

4. Offers a textual medium with a voice or video recording of the lesson and interactions, using tools such as a messaging service, discussion forums and/or chat rooms.

media input.<sup>5</sup> The biggest increases in participation occurred in 2005 and 2006. The lower left hand side of figure 1, however, shows that all the degrees on offer are on Web Enhanced Learning (WEL), which means that less than 30% of study hours are distance learning. The MCSU has yet to diversify its distance education offer to Blended or Full Online learning.

In the other two dimensions, MCSU spent, on average during the period, 0.135% of its total budget and earned 0.065% of its total incomes. This is a small financial impact. In the learning and growth dimension, MCSU appears very dynamic in terms of new partnerships and projects developed, which stand at around 20 per year. The university lectures and researchers have also participated in many conferences, up to 80 per year during the period studied.

### 3.1.2. University of Nice Sophia Antipolis (UNS)

Since 1999, the University of Nice Sophia Antipolis (UNS) – the second ranked multidisciplinary university in France – has been committed to the development of ICT-mediated learning and the support of individual initiatives as well as collective projects (Garrot, Psillaki and Rochhia, 2007). In terms of funding, it has maintained both a bilateral dimension with the Ministry of National Education, and a multilateral one, with the setting up of networks to tender

for government projects such as French Virtual Campuses. Co-operation with other higher education agents has allowed UNS to gain organizational competences in the management of collaborative projects. Although by the end of 2003 few diplomas had been gained over the web, UNS has developed several mixed media resources and specific pedagogical approaches with partners for online courses.

The development of e-learning during the five years 1999-2003 has been sufficiently important to create a department devoted solely to these activities. However, the four-year contract (2004-2007) and the latest ministerial e-learning policy have provoked UNS to change its strategy especially in organizational aspects. We look at these changes using the BSC.

From 2004, the change in the state's e-learning policy led UNS to join the Numerical Universities Region (UNR) and the Numerical Thematic Universities (UNT). The purpose of the former is to share hardware and software investments at a regional level; the latter was aimed at the sharing of already existing numerical resources in academic disciplines. Consequently, the department dedicated to ICT in learning was reorganized to initiate, support and manage any ICT integration projects and learning activities. However, this structural change has not resulted in a change in teaching practices or an evolution of learning processes (Garrett and Jokiverta 2004). Most changes have been limited to e-learning tools and to the characteristics of web courses.

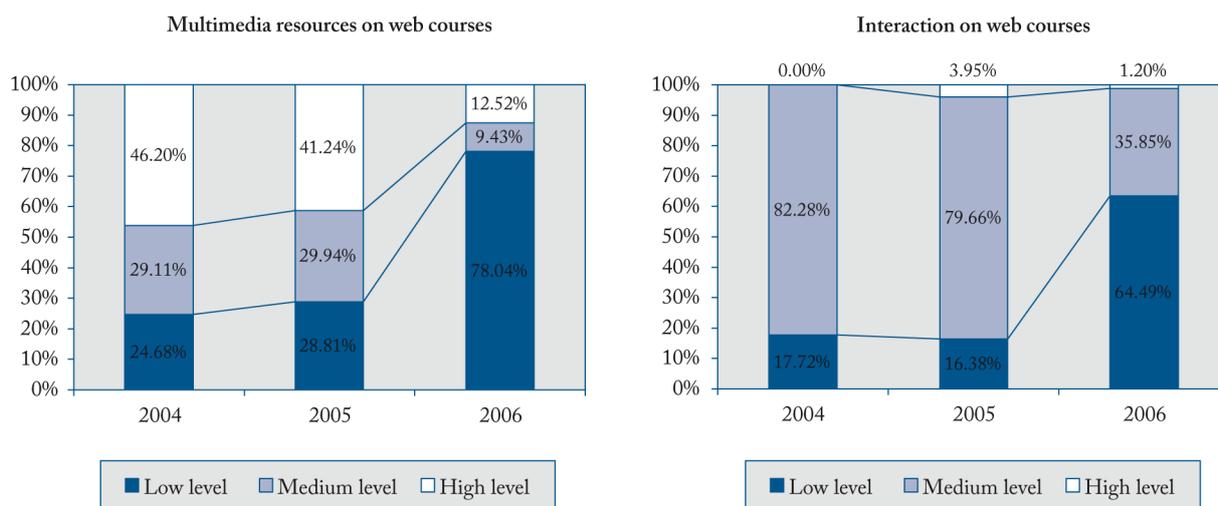


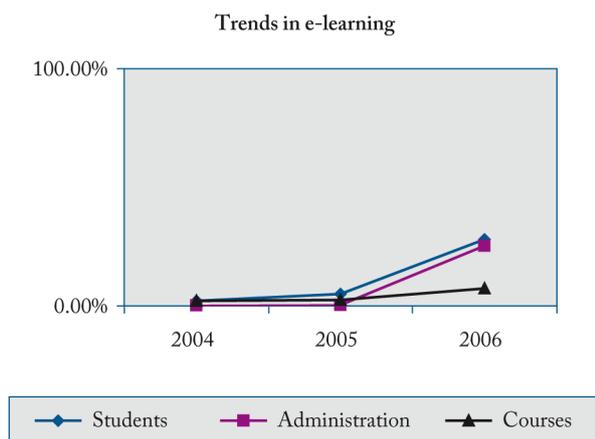
FIGURE 2: UNS indicators and data on internal business process (BSC)

5. The media input is not shown as the figure is the same as for interaction.

For the UNS, medium and high levels of interaction and mixed media use prevailed until 2005. From then, the trend for BSC indicators was to decrease. For example, the percentage of courses proposed with high levels of media interaction dropped from 46.20 in 2004 to 12.67 in 2006. A similar trend can be observed for the costs related to interconnection services, to learning content (such as courses and learning material, simulation, virtual reality) and learning interaction (such as forum, email, collaborative tools, tutorial systems, etc.). Most investments were before 2004; consequently, the investment trend is also fairly stable after this time. Moreover, the comparison between expenditures and income underlines the weakness of the UNS resources dedicated to e-learning; the increase in the financial effort is no more than 0.22 per cent over the 2004-2006 period.

Thus, 2005 can be considered a turning point in the trajectory followed by UNS. The interaction level decreases, and the evolution of courses with high levels of interaction and media use remains stable. However, in the following two years, UNS began to direct efforts towards web enhanced courses and ICT related staff training (see below figure 3).

Since 2005, the number of web-enhanced learning diplomas has risen sharply. This investment orientation directly benefits students. In 2004, only 2.06 percent of students were participating in e-learning; in 2006 this rose to 28.05 percent. At the same time, the percentage of professors involved increased from 12.42 in 2004 to 41.28 in 2006. Significant efforts have also been undertaken in the training of staff. For example, the number of professors who have undertaken training programmes increased from 5.15 percent in 2004 to 21.78 percent in 2006.



Number of students	2004	2005	2006
Online diplomas	59	95	103
Blended learning diplomas	0	18	10
WEL diplomas	489	1,179	6,884

I.3. E-learning tools training			
	2004	2005	2006
Percentage of students	0.73%	1.67%	4.01%
Hours per student	2	2	2
Percentage of lecturers	5.15%	4.76%	21.78%
Hours per lecturer	2	2.03	2.65
Percentage of administrative staff	0.28%	0.39%	25.48%
Hours per administrative staff	5	5	4

FIGURE 3: UNS indicators and data on customer and internal business process (BSC)

The UNS trajectory is currently much more oriented towards web-enhanced learning and ICT based administration. ICT use in web-enhanced learning seems to be less intensive than in online diplomas. In other words, its use tends to replace already existing tools and to facilitate teaching practices, without changing learning processes.

Moreover, in spite of efforts made in using ICT for learning, the proportion of e-learning courses that are available is still quite small: UNS has only 7 percent. However, it shows good progression because a large part of courses involve low levels of media and low levels of interaction.

Regarding the learning and growth dimension, UNS became much more dynamic in 2006, especially in terms

of conferences and projects. The e-learning ministerial policies (UNR, UNT) started in 2004 could explain the increase in these indicators.

Finally, it should be noted that, like the Polish university, UNS is devoting e-learning investment to web-enhanced courses. This investment orientation has the advantage of needing only modest financial and pedagogical commitment while benefiting a large number of students. Although the BSC indicators sometimes differ quite widely for these two universities, their evolution has been similar with regard to the characteristics of web courses (levels of interaction and mixed media). In both cases, we can see a change in their e-learning trajectories during 2005.

### 3.2. Most experienced institutions in terms of e-learning

#### 3.2.1. Nancy 2: Videoscope

In 2007, Ducreau and Lauch stated that the University of Nancy 2 (UN2), which is among the most innovative French HEIs investing in e-learning, has 20 years' experience in open and distance learning activities. Only the most significant events are described.

The implementation and use of ICT began in the late 1990s with the launch by the Ministry of National Education and Research of three calls for successive projects in 2000, 2001 and 2002 for the creation of French Virtual Campuses. Among the first innovative initiatives launched by UN2 was the operating system *News busters*, which started in the mid 1990s, in response to a request from the humanities faculty, and is still in force. But it was not until the Centre for University Distance Learning (CTU), which became ERUDI in 2007, was created, that ICT

was completely integrated into university policy. Through the Centre Videoscope, created in 1977, UN2 offers engineering and communication technology training, and intervenes as executive producer, partner or subcontractor in many academic institutions. The Ministry of Higher Education awarded Videoscope responsibility for project management and production of COMPETICE, whose goal is the design and implementation of a piloting tool for competencies in ICT. Videoscope is also a privileged partner in broadcasting led by the Ministry, including *Amphis of 5*, *Canal-U* and French universities' web TV.

At the beginning of the period, in 2004, more than 3,000 students were enrolled in e-learning degree courses (online or web-enhanced diplomas). In 2005, an important step in the process of ICT integration was made with the implementation of a digital work space (ENT) to support distant access and resource sharing in a personalized environment. Expenditures on e-learning doubled in 2005 and reached 1% of the university budget in 2006. This evolution is mostly due to a major increase in the general expenses for e-learning (a 70% increase), in which staff costs play an important role.

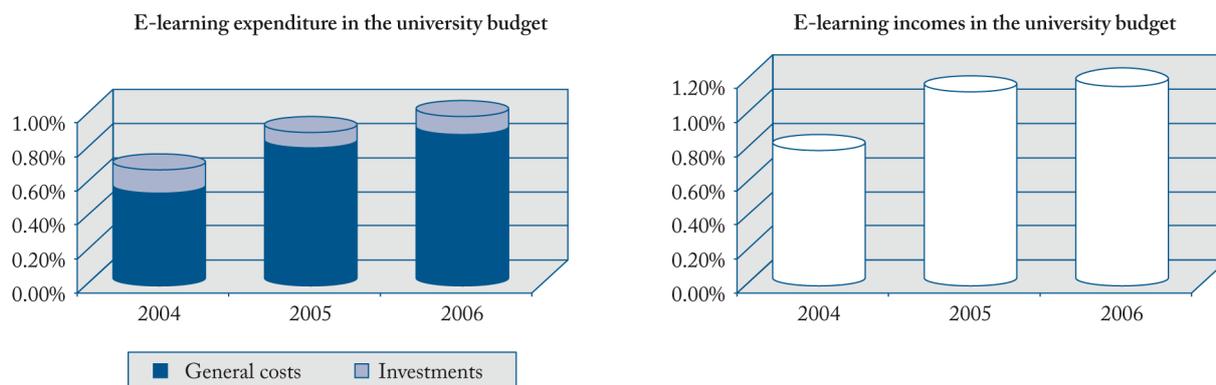


FIGURE 4: Nancy 2 indicators on financial dimension (BSC)

Between 2004 and 2006, expenditure and income grew in a comparable way, and e-learning incomes represented 1.2 percent of the university budget in 2006. A discrepancy between the increases in general expenditures and investments arose because of the duplication, in 2005, of the human resources involved in open and distance learning. This investment in human capital represented 19.3 percent of total e-learning expenditure in 2004, falling to 7 percent in 2006. Moreover, 2004 is characterized by the development of new platforms requiring initial financing. This investment in the technical framework was directed particularly towards increasing the capacity of the servers that were

required to support and manage the fast growth in traffic, and improving the quantity and quality of materials used in teaching (Rumble, 2001).

Training sessions for people (students, administrative and teaching staff) involved in e-learning increased. It is interesting to note that, despite a decrease in the total number of university students since 2004, the number of those that have been or are enrolled in ICT training increased, reaching 30 percent in 2006.

UN2 funded a great part of its e-learning activities through its involvement in a diversity of institutional projects (Ministry of Higher Education and Research, re-

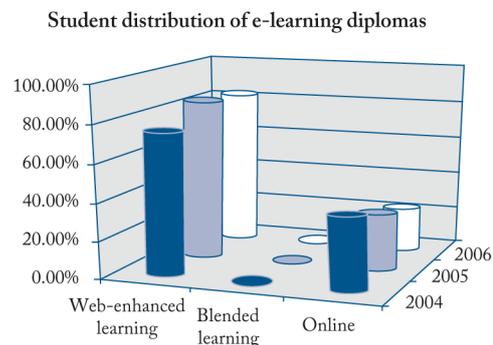
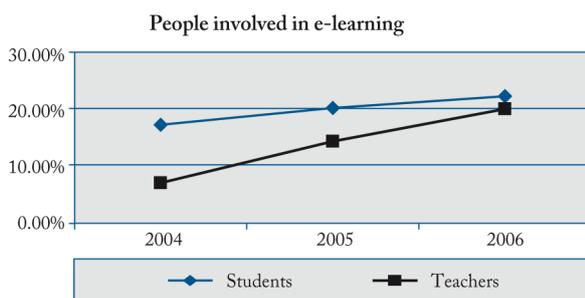
gional and European institutions). But the university had no strategy of its own to fund e-learning activities until 2005. The strategic e-learning orientation of UN2 only emerged after the four year contract (2005-2008), at the financial and managerial levels. As at other universities, the proportion of online diplomas is falling, so incomes from e-learning, which represent about 25 percent of university funding, is not growing. The number of students following e-learning diplomas increased between 2004 and 2006, but

most, around 80 per cent, were following web-enhanced diplomas. As already noted, this investment orientation has the advantage of necessitating a moderate commitment while affecting numerous students. The percentage of students and teachers involved in e-learning is increasing. This upward trend in the numbers of people involved in e-learning explains the increase in the indicators for technical capacity and training.

Customers / Students

C.1. People involved in university e-learning			
%	2004	2005	2006
Students	17.26%	25.25%	22.33%
Teachers	6.95%	14.33%	20.08%
Numbers of course/teacher	0.85%	1.19%	1.62%
Courses	12.25%	16.33%	20.99%

C.1. People involved in university e-learning			
%	2004	2005	2006
Online diplomas	24.66%	20.69%	19.32%
Blended learning diplomas	0.00%	0.00%	0.00%
Web-enhanced learning diplomas	75.34%	79.31%	80.68%
Number			
Online diplomas	805	754	776
Blended learning diplomas	0	0	0
Web-enhanced learning diplomas	2,460	2,890	3,240



C.3. Number of additional services provided online			
	2004	2005	2006
	13	13	13

FIGURE 5: Nancy 2 indicators on customers / students dimension (BSC)

Like the other three universities, UN2 has undertaken important efforts on the training of staff, teachers and administrators. However, unlike the other three universities, the proportion of UN2's courses that offer high levels of mixed-media (virtual laboratories, collaboration activities, etc.) is not decreasing. Although the figures fluctuated between 2004/2005, UN2 has generally consistently continued to develop web courses with high levels of media content. Also the level of human interaction is increasing, with a positive trend in the number of courses with

medium and high levels of interaction. The evolution of courses with low levels of human interaction has decreased dramatically (see figure 6). This can be explained by the initiatives for regular training of teachers, by experience feedback from the existing systems and by the desire to improve the quality of pedagogic support and content. The extended experience in e-learning activities explains the relative weakness of the indicators on projects; the learning and growth dimension is oriented towards conferences as most projects were established prior to 2004.

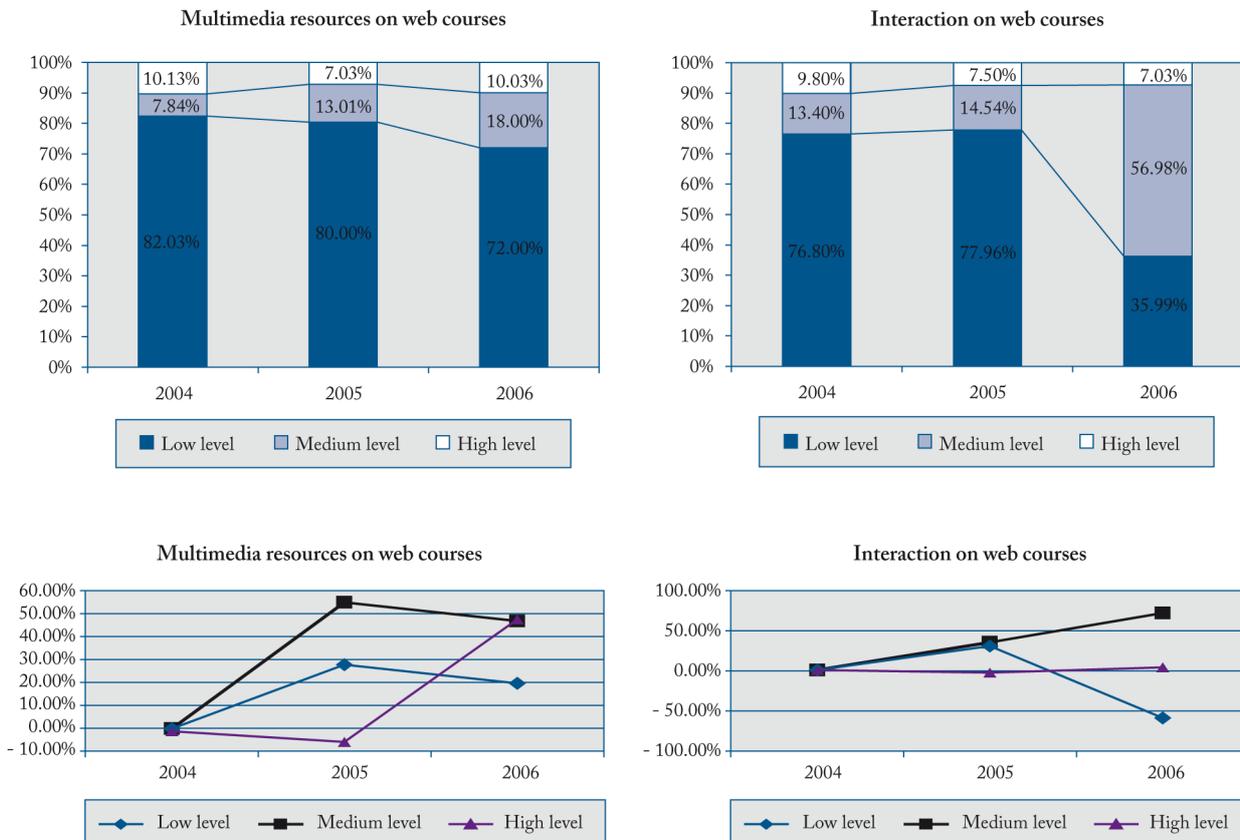


FIGURE 6: Nancy 2 indicators on internal business process dimension (BSC)

### 3.2.2. Politecnico di Milan: METID Centre

According to Sancassani and Tomasini (2007), the Politecnico di Milan was the first Italian HEI to invest in e-learning. In 1995 the Politecnico decided to concentrate on e-learning activities with dedicated staff in a specific centre: the METID Centre. METID is devoted to the *development and adoption of innovative tools and methodologies in university teaching*. In particular it promotes support for teachers and didactical innovation via the use of computers, multimedia and telecommunications technologies. METID developed and maintains videoconferencing to enable students to follow lectures from all Politecnico Campuses without the need to travel. For instance, the “Laurea On Line” is a degree in Computer Engineering and the first fully online Italian university degree. The project started in 2000, and the first students completed their degree studies in July 2003. Great attention was paid to guaranteeing a high quality offering: the same teachers and tutors were involved as in face to face courses, and the course programmes and examinations were of the same high quality. In 2007 more than 450

students were enrolled in this online degree course. In 2005, METID addressed multimedia and technological aspects in several projects targeting schools, enterprises, special contexts (prisons, people with disabilities, etc.). These projects were developed in partnership with agents external to the university: ministries, regional or local administrations, private companies, and other associations, such as syndicates, not-for-profit associations, etc. Currently the Politecnico is developing e-learning as a strategic support for three aspects: increasing the quality of the traditional didactic activities; developing new extracurricular paths (particularly related to lifelong learning); and the development of international projects where e-learning seems to provide a powerful means to enhance the internationalization of the university.

Data show that the proportion of e-learning in the university budget was 0.23 percent in 2004, 0.21 percent in 2005, and 0.26 percent in 2006. This trend is linked to the fact that a consistent part of the investment in e-learning is connected to projects funded by external institutions. But indeed, this financing depends partially on the political or economic context.

Financial

F.1. E-learning expenditure in university budget			
	2004	2005	2006
Percentage of university budget	0.23%	0.21%	0.26%
General costs	0.19%	0.20%	0.23%
Investments	0.04%	0.02%	0.03%

F.2. E-learning incomes in university budget			
	2004	2005	2006
	0.48%	0.51%	0.54%

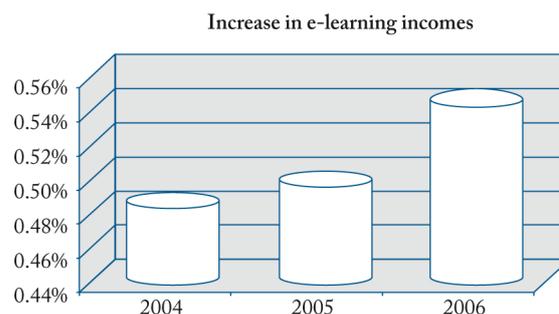
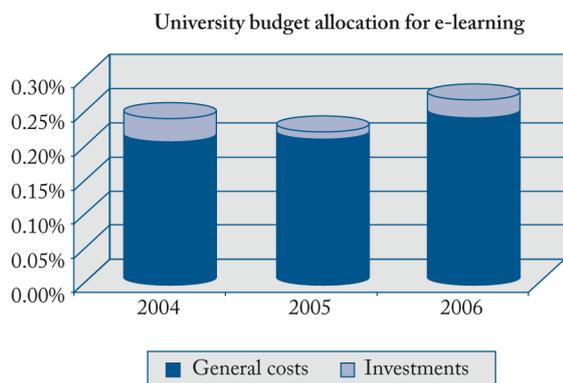


FIGURE 7: Politecnico di Milano indicators on financial dimension (BSC)

The expenditures are mainly general costs, which include staff costs. The conception and realization of an e-learning project requires a high level of human resources engagement in multimedia, software and methodology development and, moreover, detailed management and monitoring throughout the didactic path. The increase in expenses is less evident (0.01%, 0.19% and 0.20% for the 2004-2006 period) because both general costs and annual costs of e-learning showed similar increases in 2006. In 2004, the percentage of investments was 0.04 per cent of e-learning expenditures in the university budget. There was a slowdown in 2005 (investments dropped to 0.02%), because purchases in the previous year covered part of the project requirements for 2005, and then rose in the following year to 0.03%. Analysing income over the three year period 2004, 2005 and 2006, we can see a consistent increase in the amount of income for the university in e-learning: 0.48 percent, 0.51 percent and 0.54 per cent respectively. The BSC graph shows this trend very clearly.

E-learning development is funded by a variety of sources: in part directly by the university but to a greater extent externally, by public institutions or private organizations. It is important to highlight this because annual e-learning activities are strictly linked to the origin and the amount of financing. In 2006, for example, the change in the Italian government, linked to a reorganization within

public institutions, caused a temporary slowdown in the economic flux of new projects.

As can be seen in the table below, the highest figures for courses correspond to those with low levels of media and interaction: around 89% in 2004 and a slight fall to 87.11% in 2005, even though absolute numbers increased between 2004 and 2006 (low level courses represent almost the totality of web courses in each year, so the proportion remains similar). It is also interesting to point out that the number of students involved in e-learning at any level constantly grew since 2004, eventually encompassing almost all of the Politecnico's students: 69.85% in 2004 and 99.61% in 2006. However, the vast proportion of web students follow web-enhanced diplomas. Blended and e-learning diplomas represent a small part of the university's enrolment, but they are very relevant from a strategic point of view in enhancing the exploration and development of new technologies and methodologies. Learners following online diploma courses decreased from 527 in 2004 to 343 in 2006. This trend is particularly due to new and similar offerings from other universities in Italy, which are often easier and cheaper than the very selective courses offered by the Politecnico. The rate of evolution of courses with medium and high levels of ICT integration remains low, but they are very important in providing contexts for the testing and development of innovative solutions for future

integration in the standard services offered by the university. The number of courses with high levels of media and human interaction has risen in recent years, although they represent a small proportion of the total number of web

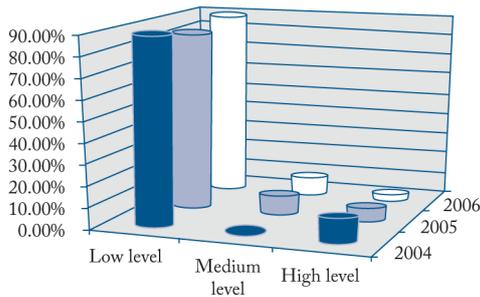
courses. Their rate decreased from 10.45 percent in 2004 to 3.64 percent in 2006 because of the parallel growth of low level media and low level interaction courses provided by the university.

Internal business process

I.1.a. Multimedia resources on web courses			
	2004	2005	2006
Low level	89.55%	87.11%	89.18%
Medium level	0.00%	7.45%	7.18%
High level	10.45%	5.43%	3.64%
Evolution rate			
Low level	ns	46.52%	34.54%
Medium level	ns	100.00%	30.43%
High level	ns	0.00%	0.00%

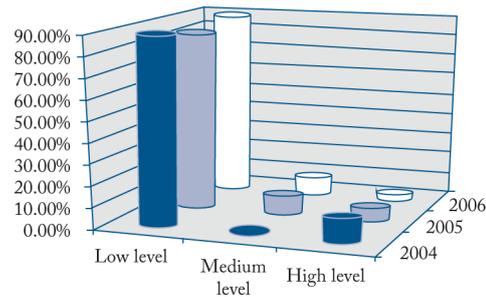
I.1.b. Interaction on web courses			
	2004	2005	2006
Low level	89.55%	87.11%	89.18%
Medium level	0.00%	7.45%	7.18%
High level	10.45%	5.43%	3.64%
Evolution rate			
Low level	ns	46.52%	34.54%
Medium level	ns	100.00%	30.43%
High level	ns	0.00%	0.00%

Multimedia resources on web courses

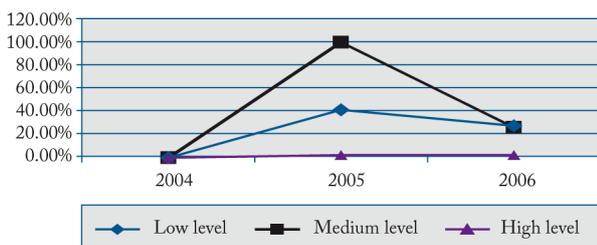


See evolution rates next page

Interaction on web courses



Evolution of multimedia resources on web courses



Interaction on web courses

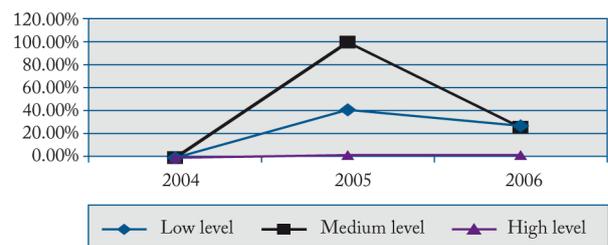


FIGURE 8: Politecnico di Milano indicators on internal business process dimension (BSC)

Courses with medium levels of ICT integration have been offered as blended Masters and extracurricular courses. Blended courses represent a very particular situation where the investments in media services and human interaction do not reach very high levels because resources are shared with the face to face courses.

Communication aspects are of great importance for all HEIs. In fact, as the data show, the e-learning activities of the Politecnico are well advertised and encourage the creation and fostering of partnerships with national and international institutions and companies.

Learning and growth

Events brought by e-learning activities			
	2004	2005	2006
Conferences	68.00%	45.00%	38.00%
Projects	13.00%	19.00%	25.00%
New partnerships	20.00%	46.00%	16.00%

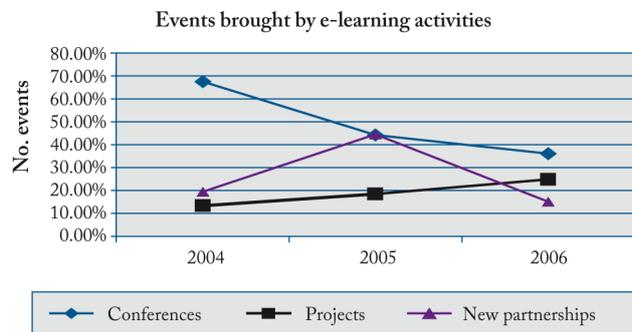


FIGURE 9: Politecnico di Milano indicators on learning and growth dimension (BSC)

As the data show, 2005 recorded the highest number of events; this depends, in part, on the number of mentions in the printed media. In 2006 the data show an increase in the number of new projects, which reached 25. In 2006 there was a rise in Politecnico staff participation in national and international conferences, both as participants and presenters.

#### 4. Conclusion and discussion

Among the participants in the workgroup, some have responsibilities for the management of e-learning activities in their institutions and they had a first hand opportunity to test the BSC approach during the last months of 2007. Initial feedback is available. The period of experimentation is too short to draw any firm conclusions on the use of BSC, but it is interesting to make a preliminary analysis of its impact on the management of HEIs, one of our original goals. Susanna Sancassani, managing director of the Centre METID, Politecnico di Milano, experimented with it for a board meeting and emphasized the following points:

“E-learning is a complex field which needs a ‘multifaceted’ approach for a good strategic comprehension: we discovered a lot about ourselves! We are able now to show to stakeholders (METID Scientific Committee, university decision makers but also teachers and students) how, really, e-learning impacts the life of the university. At least, it is important to personalize the model to a specific context by introducing or modifying single indicators” (Sancassani and Tomasini, 2007).

An extended version of the METID feedback will reveal success factors or initial hypotheses, by analysing the

four case studies. During our two years of work, several things became clear. First, the total cost of e-learning activities in the university budget. For the most experienced partner with more than 20 years of activity, the proportion was 1 percent and for the least experienced it was less than 0.2 percent. Many people, including the members of WP3, had perceived e-learning to be “very costly”. In terms of the changes provided by ICT to learning activities, the financial implications for the universities studied were quite small. And deeper analysis of the financial data reveals that within a few years incomes exceed expenditure. Indeed, e-learning becomes a profitable activity when the universities involved develop external partnerships.

Other evidence comes from the analysis of the degrees offered in terms of e-learning services. All the partners first implemented or reoriented their strategic goals to WEL. WEL has become a standard offering for students at one institution. Before the structural changes were announced, it seemed necessary to increase ICT-based equipment and examine its use. However, the emphasis on WEL shows that universities had some difficulty in developing fully online degree courses with high levels of interaction and media involvement. As we have shown, WEL consists of the transformation of traditional lectures into a multimedia format. But the provision of full online degree courses, of high quality, requires more than mere substitution or transfer. It requires a change in didactics and an evolution in teaching practices and learning processes (Garrett and Jokivirta, 2004). Blended learning is marginal in our sample of universities, but there are certain actors that see it as another path towards cultural change.

Although this study provides comparative data for three European countries and four case studies, it has some limitations. The BSC was clearly designed for HEI deci-

sion makers and to provide answers for management and organization in university e-learning activities. It might be considered rather bold to use this data set for comparison and to describe e-learning development in HEIs. In order to achieve a more coherent approach and the possibility of extending the comparison, it will be necessary to develop new tools. These tools should allow the conceptualization of the trajectories of universities with the dual goal of identifying critical strengths in the progression of e-learning activities in higher education systems, and designing strategies to inform and help institutions in the management of e-learning activities. A preliminary report was presented in Paris in December 2007, but has to be tested and developed. It needs to fully address questions such as: Are Virtual Campuses a good way to manage e-learning activities? And, if so, what kinds of activities? (Stanfield, 2007).

A return to Kaplan and Norton's (1997) proposition would be useful. The BSC application should not be limited to a simple performance measurement of open and distance learning activities. As these authors affirm, "Balanced Scorecard is management not measurement". It is rooted in a global concept of organization focused on strategic aspects and therefore represents an ideal instrument to move a complex organization, such as a university, forward in the achievement of a collective vision and objective. This approach should be generalized to all areas of HEI in order to be coherent with higher education, research, continuing education and e-learning, but this is a separate goal.

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## Recommended citation

GARROT, THIERRY; PSILLAKI, MARIA; ROCHHIA, SYLVIE (2008). "Describing E-learning Development in European Higher Education Institutions Using a Balanced Scorecard". In: "The Economics of E-learning" [online monograph]. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 5, no. 1. UOC. [Accessed: dd/mm/yy]. <[http://www.uoc.edu/rusc/5/1/dt/eng/garrot\\_psillaki\\_rochhia.pdf](http://www.uoc.edu/rusc/5/1/dt/eng/garrot_psillaki_rochhia.pdf)>



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## About the authors

Thierry Garrot

Associate Professor in Management, University of Nice Sophia Antipolis

[Thierry.Garrot@unice.fr](mailto:Thierry.Garrot@unice.fr)

Thierry Garrot is Associate Professor in Management, Institute of Business Administration, at the University of Nice Sophia Antipolis. He has considerable experience in lifelong learning projects and e-Learning degrees. For more than five years, he was the director of the Lifelong Learning Education Centre of his university. He participates in the European eLene-EE<sup>www1</sup> project on the economics of e-learning and coordinates the work-package on the indicators of e-Learning.

*Maria Psillaki*

Associate Professor of Economics, University of Nice Sophia Antipolis

[maria.psillaki@gredeg.cnrs.fr](mailto:maria.psillaki@gredeg.cnrs.fr)

Dr. Maria Psillaki is Associate Professor of Economics, University of Nice Sophia Antipolis (UNSA), GREDEG-CNRS. She participates in the European eLene-EE<sup>www1</sup> project on the economics of e-learning.

*Sylvie Rochhia*

Associate Professor of Economics, University of Nice Sophia Antipolis

[rochhia@gredeg.cnrs.fr](mailto:rochhia@gredeg.cnrs.fr)

Dr. Sylvie Rochhia is Associate Professor of Economics, University of Nice Sophia Antipolis (UNSA), GREDEG-CNRS. She participates in the European eLene-EE<sup>www1</sup> project on the economics of e-learning. Director of the Bachelor Economics & Management online undergraduate programme of CANEGE<sup>www2</sup> (numerical Campus) since 2001, she has also been responsible for developing ICT at the faculty of Law, Economics and Management since 2004, and a member of the UNT (numerical University) AUNEGE<sup>www3</sup> since 2005.

[<sup>www1</sup>] <http://www.elene-ee.net>

[<sup>www2</sup>] <http://www.canege.org/accueil.htm>

[<sup>www3</sup>] <http://www.aunege.org>