

## Monograph “The Economics of E-learning”

## ARTICLE

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

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