In: *Basic Education at a Distance. World review of distance education and open learning; Vol.2,* 2000; - Edited by Chris Yates and Jo Bradley;- London: Routledge; - pp. 138 - 151

Finance, costs and economics

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It is sometimes argued that new information and communication technologies will become a powerful tool for eradicating illiteracy in the world more rapidly and more efficiently than would have been the case with traditional approaches. Such a view is highly disputable, because it ignores the fact that budgetary constraints in the financing of education are increasingly severe. Several authors have developed a theory according to which there exists a world system of education, meaning a converging trend of educational systems worldwide, and this trend is supposed to have a kind of autonomy with respect to economic development and, economic disparities among countries. This theory is not supported by recent evidence, as shown by education indicators. The economic gap between rich and poor countries is increasing, as well as the gap in access to education. This new trend is closely linked to shortages of resources in the least advanced countries, and new technologies will not bring any easing in this resource constraints Quite the opposite, for while the introduction of new technologies will have a limited impact on education budgets of developed countries (1 per cent to 5 per cent at the most), its impact on the education budgets of poor countries would be huge. For the first time in the history of education systems, the price of an educational input is determined not in accordance with the local purchasing power, but by world standards which apply in a similar way to rich and poor countries. As a consequence, the least advanced countries have a simple choice to make: either they introduce new technologies in their schools at the expense of expanding school opportunities to currently excluded children, or they concentrate their limited resources on educational expansion, and thus renounce the chance to develop new technologies in their school systems. As long as gross domestic product (GDP) per capita remains highly unequal from one country to another, the capacity of new technologies. to reduce the education gap will not constitute a viable option.

The world system of education theory

Long before the introduction of 'economic globalisation', several authors developed the thesis of a world system of education. In particular, Meyer *et al.* (1977), or

more recently Meyer (1999), have shown that the model of mass education initiated in developed countries is spreading in less developed countries significantly earlier than the achievement of the same level of economic development. This phenomenon was less true in the eighteenth and nineteenth centuries, when industry expanded in western Europe and north America. During this first phase of economic growth, education was led by economic expansion, both because the job market wanted more and more qualified workers, and because higher incomes eased the economic constraint, allowing the allocation of more resources for educational development. Of course, economic wealth was not the only cause of education expansion. For example, the Christian reform, namely the move from Roman Catholicism to Protestantism, was also a key element in spreading literacy quite early in some north European countries (believers were expected to be able to read the Bible). But, quite clearly, mass education followed rather than preceded economic expansion during this period.

After the Second World War, this sequence was reversed. Education started to develop in countries where economic development was still at a standstill. Education was promoted as a 'right', prescribed in the Declaration of Human Rights. UNESCO was created, becoming a world centre where international education authorities met in general assemblies, disseminating educational ideas and models. An international standard classification of education (ISCED) was adopted, facilitating the harmonisation of education systems across countries. In the late 1950s and early 1960s, a new economic theory, human capital theory, promoted the idea that education was a powerful factor of economic development. Contrary to previous economic orthodoxy, education should no longer be considered as consumption, but as an investment, generating flows of additional income and economic wealth during the whole life of educated individuals. As a consequence, in order to promote economic development, education was a desirable prerequisite, and many countries became convinced that education should expand at an accelerated rate for subsequent economic expansion.

In addition, several international conferences adopted common declarations for achieving the objective of universal access to education services as early as possible. The Addis Ababa conference held in the early 1960s fixed a precise agenda for attaining this objective by 1980. When 1980 passed, realisation of the objective was still far away in the future, and the Jomtien Conference in 1990 reiterated it with a new deadline, the year 2000. Now the new millennium has arrived, and universal access to basic education is still a remote objective in many poor countries. Today, the same group of international development agencies has set new deadlines, such as gender equality for the year 2005 and universal access to basic education for 2015, but, as some researchers have already claimed (see for instance Watkins 1999), such objectives remain unrealistic in a number of countries.

During the three decades that followed the Second World War, the general trend, with respect to educational development, could be characterised as a 'converging' trend. Less developed countries were progressively closing the gap

with developed countries. Between 1960 and 1980, net schooling ratios for 6- to 11 -year-old children, close to one hundred in the developed world, increased dramatically in the developing

one, from 58 to 83 per cent in Latin America, from 54 to 70 per cent in Asia, and from 30 to 59 per cent in Africa - a near doubling of the ratio -in the last case. Furthermore, access to secondary and tertiary education, which arrived several decades after the achievement of universal primary education in developed countries, started to grow at the same time. Unlike the dominant pattern seen in developed countries, there was no pause between the development of primary education and that of secondary. In France, for instance, primary education became general in the 1880s, while secondary education started to move towards mass education only in the 1950s, seventy years later.

At the same time, education budgets were expanding at an even faster rate. The share of GNP allocated to the sector from public sources increased from less than 2 per cent in 1950 to about 5 per cent in t975. Here again, we observe a significant difference from the earlier Western model: during the first industrial revolution in Europe, education expenditure had a very low share of GNP, no more than about 1 per cent. In fact, public involvement in the early stages of education development was extremely limited. The bulk of education expenditure was born by families and churches. This is another important contrast with the current situation of the least developed countries, in which it is more difficult to generate private finance for educational development. There are two reasons for this change. First, least developed countries are poorer now, in absolute terms, than were the industrial countries in the nineteenth century, when universal access to primary schooling was achieved. Second, least developed countries have been exposed to new models of education provision, unlike their predecessors. The model of publicly financed education is predominant, and largely viewed as a better approach to educational finance than family- or church-based models.

Our purpose, in the following sections, is threefold: to show, first, that the world system theory for education has lost a great deal of its pertinence in the recent past, due to a serious tightening of economic constraints; second, that besides the budgetary constraint the major cause of the gap in educational opportunities among countries is linked to demographic structure; and third, that it is unlikely that new information and communication technologies (NICT) will provide a feasible and sustainable solution, in general, to this problem in least developed countries.

Why the world system theory is outdated

The world system theory is based firstly on the assumption that education systems worldwide are converging more rapidly than economies. Actually, the opposite trend is operating, for both education and economies. The gap between the developed and the least developed countries is growing, in spite of the fact that the group of developing countries, taken as a whole, is growing more rapidly than

Table 8.1 Average GNP per capita in developed and least developed countries

Unit: current US $

	1979	1983	1992	1995
Least developed countries[a]	240	200	370	290
Industrial market economies	9,440	11,060	22,160	24,930
Ratio developed : least developed	39	55	60	86

Sources: World Bank (I 981, 1985, 1994, and 1997)

Note

a Excluding India and China.

the group of developed countries. This is because within the developing world, certain countries are progressing rapidly while others are stagnating. And it is the gap between the richest and the poorest countries which is increasing.

As shown in table 8. 1, the wealth gap between developed and least developed countries' has increased significantly over the past two decades, from a ratio of I to 39 to a ratio of 1 to 86. This is an enormous gap, and it is not without consequences for the supposed 'converging' process of educational systems.

In order to measure educational development, one needs education indicators which have the same kind of pertinence as GNP per capita has for measuring economic performance. The most common indicators are participation rates, calculated by level of education, gross or net. But rates of schooling have a drawback: one has to deal with a set of three (primary, secondary and tertiary), which makes comparative exercises more complex. A new synthetic indicator has recently been developed, which is quite convenient for the purpose of this chapter, namely the expected number of years of education a five-year-old child will receive. Table 8.2 presents values of this indicator for a number of geographical areas, including developed and least developed countries, and shows the evolution of the indicator for the last decade.

Two comments are suggested by these data. First, they show that the variability of the indicator between regions is quite large, a ratio of almost I to 3 when comparing developed and least developed countries (14.77 years in the case of developed countries, 4.93 years in the case of least developed ones). Second, they indicate that during the last decade, the gap between well-endowed countries and others has not narrowed, but widened. The largest gain has benefited the children of developed countries (plus 1.78 years of expected schooling), while least developed countries gained only 0.39 years. Transition countries, which before the collapse of the former Soviet Union used to be close to developed countries, have seen the value of the indicator declining by 0.66 years, creating a gap of almost two years if one adds the gains of the latter group. Apart from developed countries, there have been important gains for both Chinese and Indian children. Undoubtedly, the movement towards a unified world system of education has been significantly affected, to say the least, during the recent period.

Table 8.2 Expected number of years of education at age five

	1985	1995	Difference
Transition countries[a]	13.02	12.36	- 0.66
Developed countries	12.99	14.77	1.78
Least developed countries	4.54	4.93	0.39
Sub-Saharan Africa	5.41	5.54	0.12
Arab states	7.58	8.45	0.87
Latin America and Caribbean	9.40	10.17	0.77
East Asia and Oceania	9.01	10.39	1.38
of which China	9.06	10.79	1.73
South Asia	6.85	8.09	1.24
of which India	7.68	8.68	1.00

Source: Author's estimates, from UNESCO data

Note

a Transition countries refers to a group of countries that used to have central planned economies until the breakdown of the former Soviet Union (FSU). It is a group that Includes 15 republics previously belonging to the FSU, and 12 central and eastern European countries associated with the FSU.

On the other hand, there is an indicator which can be characterised by a converging pattern, and that is precisely the budgetary constraint. The most widespread indicator by which economists assess the level of resources allocated to education in a country is the percentage of GNP dedicated to the sector. Ideally, this indicator should include both public and private resources, but for lack of appropriate information, it is usually limited to public resources. This limitation does not raise a major issue, insofar as the bulk of education expenditure, about 85 per cent, is home by public authorities, and ultimately by taxpayers. We saw above that from 1950 to 1975 this indicator significantly increased, from 2 to 5 per cent, allowing a rapid development of educational systems worldwide. But after 1975, this trend stabilised, and the only changes were precisely a movement towards a greater convergence: countries significantly below the 5-per-cent threshold tended to become closer, while those which went beyond the threshold tended to come back to a lower level of public expenditure (see table 8.3).2

Transition countries have reduced their share from 7.5 per cent in 1990 to 5.2 per cent in 1995. It is probably even lower currently, because the economic crisis has continued since 1995. Arab states have also reduced their share from 5.8 per cent to 5.2 per cent, because oil revenues have similarly declined. Developed countries have stabilised their share at about 5 per cent, and the other regions below the threshold have made slight increases, with the noticeable exception of the least developed countries, which are on a declining trend but below the threshold. It is also worth mentioning that China is on the same slope, but for different reasons, insofar as table 8.2 shows a significant improvement of education opportunities in this country.

It is difficult to explain this converging trend. It does not result from any international conference or organisation having recommended such a target, nor from an economic analysis showing that it was desirable for enhancing the rate of

Table 8.3 Public expenditure on education as a percentage of GNP

	1980	1985	1990	1995
Transition countries	**6.4**	**6.3**	**7.5**	**5.2**
Sub-Saharan Africa	**5.1**	**4.8**	**5.1**	**5.6**
Arab states	**4.1**	**5.8**	**5.2**	**5.2**
Latin America and Caribbean	**3.8**	**3.9**	**4.1**	**4.5**
East Asia and Oceania	**2.8**	**3.1**	**3.0**	**3.0**
of which China	**2.5**	**2.5**	**2.3**	**2.3**
South Asia	**4.1**	**3.3**	**3.9**	**4.3**
of which India	**2.8**	**3.4**	**3.9**	**3.5**
Least developed countries	**2.9**	**3.0**	**2.7**	**2.5**
All developing countries	**3.8**	**3.9**	**3.9**	**4.1**
Developed countries	**5.2**	**5.0**	**5.0**	**5.1**
World	**4.9**	**4.9**	**4.9**	**4.9**

Source: UNESCO (1998)

growth of GNP. The atypical case of least developed countries can be explained by the wave of structural adjustment plans which have affected a significant proportion of the group's members, and have more or less obliged them to reduce public expenditure in general, and consequently, very often, education expenditure, in order to eliminate permanent public deficits.

But there is no such thing as an implicit 'law' forbidding the allocation of more than 5 per cent of the GNP to public education expenditure. C)ne might have anticipated quite the opposite, because education needs do not slow down with time, and it is a sector in which productivity improvement is not as high as in the rest of the economy. There are two possible types of explanation. First, education ministries are not powerful lobbies in governments, and they fail to attract a bigger share of the cake. Second, it has been widely argued, during the 1980s and 1990s, that education resources are badly managed, and not efficiently used. Before any increase in the resources allocated to the sector, a full range of incentives should be introduced to enhance efficiency measures. If these arguments are correct, the 5-per-cent threshold could be seen as only temporary, one which could be removed if they are appropriately addressed.

Why the same amount of resources does not lead to similar education outcomes across countries

The converging trend in resource allocation for education has *de facto* increased the gap in educational opportunities between countries. Here the measure of educational outcomes is a purely quantitative indicator, the expected number of years of education at the age Of five, and therefore does not deal with the qualitative dimension of educational systems. But this limitation does not raise a particular problem in the framework of the present analysis, because quality issues are relevant for children already in schools, and not so much for those who are still excluded.

Our analytical focus concerns access to education, which is a prerequisite for addressing the qualitative aspect of education supply.

If the budgetary constraint (5 per cent of GNP) is observed, the expected number of years of education is determined by two additional variables: the unit cost of providing one year of education to a child, and the dependency ratio, which indicates the relative size of the school-age population across countries. Others things being equal, a country with higher unit costs provides fewer years of education than a country with lower unit costs, and a country with a higher dependency ratio does not give as many years of education to its school-age population as a country with a lower dependency ratio.

Unit cost variability

Unit cost comparisons at the international level are based on indicators using total education expenditure for a given ISCED level (or two ISCED levels combined if that improves the comparability of data), for instance primary, secondary or tertiary. This total is divided by the number of pupils enrolled at the corresponding level. This gives a preliminary result expressed in the national currency, which does not allow direct comparisons. To make interpretable comparisons, it is necessary to transform these data into a common measurement unit. Two options are available. The first is based on using a dominant currency, such as the US dollar. This method has two flaws: a problem of excessive exchange fluctuations over time, and a problem of large price differences for similar inputs. The second method avoids these shortcomings, and is increasingly used in the literature. It estimates unit costs as a percentage of GNP per capita. This approach is based on the observation that most education inputs, from teachers' pay to furniture, from textbooks to school buildings, have their prices closely correlated with per capita GNP in the country.

Concerning the unit cost of the primary level, which is the key level addressed in th is chapter, two patterns are observable (see table 8-4): a group of regions in which unit cost represents more or less 20 per cent of GNP per capita, and another group where it is closer to 10 per cent. In the first case, one can supply five students with a year of education by allocating the equivalent of one GNP per capita to the sector. This also means that with 5 per cent of GNP, 25 per cent of the population can be in school. In the second case, one can supply ten years of education for each GNP per capita. The first group includes developed countries, transition countries, sub-Saharan Africa and the Arab states. The second group includes all other developing regions. For secondary education, the 'expensive' group is limited to sub-Saharan Africa, where unit cost is three times the world average. For tertiary education, sub-Saharan Africa is once again the most expensive region (eight times the world average), and least developed countries are also quite costly (four times the developed countries ratio). Whatever the level, sub-Saharan Africa is either as expensive as the high cost group, or the most expensive of all regions. As the share of GNP allocated to education by sub-

Table 8.4 Unit cost as a percentage of the GNP per capita

	Primary		Secondary		Tertiary	
	1985	1995	1985	1995	1985	1995
Developed countries	17.3	19.9	17.3[a]	19.9[a]	30.5	25.5
Transition countries	18.8	17.9	18.8[a]	17.9[a]	26.5	21.7
Least developed countries	9.7	9.2	26.0	29.2	153.9	125.6
Sub-Saharan Africa	16.4	17.0	57.5	57.6	481.5	433.9
Arab states	24.9	20.5	24.9[a]	20.5[a]	115.6	73.5
Latin America and Caribbean	5.9	9.1	14.8	13.1	30.4	27.2
East Asia and Oceania	7.2	8.8	18.1	18.1	93.1	70.3
South Asia	10.7	10.2	17.7	21.3	77.6	89.1
World	17.5	18.2	17.5[a]	18.2[a]	66.1	58.2

Source: UNESCO (1998)

Note

a For these regions, primary and secondary levels have been merged, due to data availability.

Saharan African countries is close to the world threshold of 5 per cent, the current cost structure implies that fewer children can have access to education than in the rest of the world.

Dependency ratio variability

The purpose of a dependency ratio is to measure the relative size of the school-age population with respect to the potentially active population, namely people who are generating the GNP. It is quite easy to understand that countries with a high dependency ratio (many school-age children per active adult) will find it more difficult to provide them with education than countries where this ratio is significantly lower. Table 8.5 shows clearly how the situation in the main world regions varies in this respect. Developed countries, transition countries and China share a common characteristic, namely a low and declining dependency ratio. At the other end of the spectrum, sub-Saharan Africa is characterised by a high dependency ratio, which is not declining- In 2005, it will still be three times higher than in the developed world. Most other developing regions of the world also have relatively high dependency ratios, in particular the Arab states and the group of least developed countries, although following a declining trend.

The role of the dependency ratio in explaining interregional differences in the provision of education is central. If cost were the same everywhere, sub-Saharan Africa would need to allocate about 15 per cent of its GNP to education in order to provide the same number of expected years of education to its school-age population as developed countries. It is an extraordinarily difficult challenge, because in many countries belonging to this group, total public

resources (fiscal revenues) are not very much higher than 15 per cent. Least developed countries are characterised by a large informal sector, with a low level of monetarisation

Table 8.5 Dependency ratios (% 6-15 year-olds/ 16-65 year-olds)

	Dependency ratio (%)			Dependency ratio (Index = 100 for developed countries)		
	1985	1995	2005	1985	1995	2005
Transition countries	**22.2**	**23.0**	**16.7**	**116**	**133**	**104**
Sub-Saharan Africa	**46.0**	**46.5**	**44.9**	**241**	**269**	**281**
Arab states	**43.3**	**41.2**	**35.0**	**227**	**238**	**219**
Latin America and Caribbean	**37.8**	**32.5**	**26.8**	**198**	**188**	**168**
East Asia and Oceania	**31.9**	**25.8**	**21.6**	**167**	**149**	**135**
of which China	**29.6**	**23.5**	**19.3**	**155**	**136**	**121**
South Asia	**38.0**	**36.9**	**30.2**	**199**	**213**	**189**
. of which India	**35.8**	**34.0**	**28.0**	**187**	**197**	**175**
Least developed countries	**45.6**	**46.1**	**40.8**	**239**	**266**	**255**
Developing countries	**36.2**	**32.8**	**28.3**	**190**	**190**	**177**
Developed countries	**19.1**	**17.3**	**16.0**	**100**	**100**	**100**
World	**31.9**	**29.6**	**25.8**	**167**	**171**	**161**

Source: UNESCO (I 998) plus author's estimates

(households tend to consume their own production, not to exchange it), and consequently a low level of taxable income.

Which of these two factors, unit cost differences and dependency ratio variability, is responsible for the largest part of the unequal access to education between rich and poor countries? In Asia and Latin America, the higher dependency ratio tends to be balanced by lower unit costs, especially at the primary level. China is a special case, where the dependency ratio has fallen dramatically, and where unit costs are also very low. This unusual combination of factors allows China to allocate a lower percentage of GNP to education without sacrificing the objective of expanding education opportunities. In addition, having a relatively low level of social expenditure, China is able to allocate more resources to physical investment. Such a mix of resource allocation favours economic growth, which has reached a highly enviable level during the past decade.

As far as sub-Saharan Africa is concerned, the unit cost factor is not negligible, although for basic education it is not so different from that of several regions, such as developed countries, transition countries and the Arab states. Nevertheless, if these unit costs were as low as in Asia or Latin America, the expected number of years of education could be multiplied by two. But if the dependency ratio were the same as in developed countries, this number could be multiplied by three. In a sense, the disadvantage of having a high dependency ratio is more damaging than

the fact of having an inadequate cost structure. Such a conclusion may have some policy relevance in terms of priorities, but it has to be remembered that both factors are difficult to manipulate, and furthermore that it is easier to manipulate unit costs than fertility rates.

Can NICT help least developed countries to expand basic education?

There have been numerous studies on the potential of technology for education in the context of developing countries (e.g. Perraton 1984, Orivel 1985). The major conclusions of these studies are as follows: first, the use of radio in schools can be a cost-effective instrument due to very low cost per student hour, while television is less likely to be cost-effective, due to significantly higher costs. Second, distance education can also be a powerful means of improving access and cost-effectiveness, but is more likely to be successful in the context of upper secondary and tertiary education than in basic education for school-age children. And third, some successful attempts have also been made to provide basic literacy to adults at a distance, through radio, television and printed material But no convincing cost-effectiveness studies exist about the utilisation of technologies in which computers are the key input. When we refer today to new information and communication technologies (NICT), it is technologies based on multimedia systems which are meant, and no longer radio and television. These are technologies based on numerical systems, not on analogue systems, as was the case with the first generation of education technologies.

That does not necessarily mean that previous technologies are outdated. Radio can still be used in a cost-effective way, as recently shown by Nekatibeb (1998), in his study of primary education radio support programmes in Ethiopia. But the purpose of this chapter is different: it tries to assess whether NICT today constitute a promising way of solving education problems in developing countries, especially basic education in the group of least developed countries, where the greatest proportion of school-age children excluded from primary education are concentrated.

Education economists expect from NICT an impact on the productivity of education services. One can learn from different inputs, such as teachers, peers, parents, books or NICT If some of the learning process shifts from the teacher to NICT, and the cost of a learning hour is cheaper with NICT as compared with one hour of face-to-face teaching, then the productivity of education services may increase. This productivity increase will be real if knowledge acquired is similar in both cases. There are some instances in which this assumption is verified. Let us look at learning activities for which NICT are as effective as face-to-face contact.

Information on the cost of learning through NICT is, as yet, limited. For instance, in the ERIC database, 4 there are 3,200 references for which the two research keywords are 'education' and 'Internet', but zero when 'cost' is introduced as a third keyword. One can only regret that such limited attention is given to this topic, but on the other hand, the rapid evolution of prices in this domain constitutes a highly discouraging factor, because the data are obsolete after a very short period.

The costs of NICT have an interesting feature when compared with other educational inputs: they are not linked to a national price structure, but quite the

opposite, they tend to be similar worldwide for equipment, software, spare parts and consumables. The cost of the electricity used to operate this kind of equipment may vary from one country to another, but electricity represents a modest share of the cost of NICT The only exception is for covering the cost of specialised staff in charge of operating the equipment, if any. In many cases, this is done by existing teaching staff, whose cost is the same, per hour, as for traditional teaching. It is therefore not a differentiating factor between face-to-face and NICT. As a consequence, cost information generated in the context of a given country may have some relevance for others. It entails a certain margin of error, but this cause of error is probably smaller than the obsolescence of data over time.

A handful of recent cost studies of NICT in schools has been identified, one for the USA, one for France, and two in Latin America (Chile and Costa Rica). The American study, carried out by Coley *et al.* (1999), is based on a representative sample of American schools, which allows comparisons, national averages and national extrapolations. It shows that in the US there is on average one computer per ten pupils and one multimedia computer (the latest generation of computers) per twenty-four pupils. The total annual expenditure generated by this equipment (investment, maintenance and operating costs, including peripheral devices such as printers and the like, software etc.) is about $3 billion, or $70 per student. This represents 1.3 per cent of the total education expenditure of American schools. One observes a significant variability from one state to another, with a minimum of six pupils per computer in Florida to a maximum of sixteen in Louisiana. Schools which seem to have the best equipment allocate about $300 instead of the average of $70. The best equipped schools have replaced the school computer laboratory, where each individual class goes once or twice a week, with classroom-based computers, with a ratio of five pupils per computer (even less in the best cases). If all schools were equipped like the best ones, it would cost about $13 billion per year, or 5.3 per cent of the consolidated education budget.

The study does not provide data on the average number of hours which pupils spend learning with computers. The intensity of use is reported from a 1994 survey, which is unfortunately probably outdated, but constitutes apparently the only available source of information in the US. Based on this survey, the average time spent on computers per pupil is 40 hours a year. As the annual cost is $70, the cost per hour/per pupil is therefore $1.75.

The French study (Talpin 1999) was carried out in the Burgundy region. In France, the availability of computers is lower than in the US: one computer for seventeen pupils in junior high schools, and one for thirty in primary school which makes an average of about one computer for twenty-four pupils, 2.4 times less than in the US. But as in the US, schools are unevenly equipped, and the study concentrates on schools having regular computer practice (on average one session of 1.5 hours a week or about 50 hours a year). The annual cost per pupil is about FFI,000, which is FF20 per pupil per hour. This is slightly more than in the US, because some schools do not rely on the class teacher for computer practice, but use a recently created body of young school assistants,' recruited by the MOE in 1997-8. In schools where there are no assistants, the unit cost per student/

hour is half as high, namely about FFIO or $1.67, close to the American cost. The monograph on which this estimate is based used a sound economic methodology, amortising equipment on

the basis of the observed life expectancy of material in schools, and including maintenance and software costs, as well as electricity consumption.

The two Latin American case studies are quoted in Perraton and Creed (2000). They show slightly lower costs (from $22 to $83 per pupil, according to the size of the school), but are not strictly comparable with the two previous case studies. First, they are projected costs rather than actual, and second, they do not relate per-pupil yearly cost to an observed number of learning hours with computers. It is assumed, in the Chilean case, that pupils are exposed to a 'maximum of two hours per week', which says nothing about the actual average. They also show that in these middle income countries, technology represents a significantly higher share of the unit cost than in developed countries, namely 10 to 37 per cent in Chile, 13 per cent in Costa Rica, compared with the less than 5 per cent (actually closer to I to 2 per cent), observed in developed countries. Given these uncertainties, it is reasonable to conclude that the Latin American case studies do not contradict the results obtained from the North American and French cases.

Let us assume that in a school environment, the hourly cost of using a computer is about $1.7. This $1.7 covers the amortisation cost of the computer (without charging a discount rate), maintenance, software and electricity. It also includes additional equipment such as printers, networking equipment, and some specific furniture. As far as the Internet connection is concerned, it includes the subscription to a provider, which is a fixed cost, plus a lump sum for using a telephone line (half an hour a day at local call rates). These costs, which are observed in the context of developed countries, cannot be lower in the context of developing ones, where the technological environment is poorer. Is this competitive with face-to-face learning? It is clearly competitive in developed countries, where a learning hour with a teacher costs between $4 and $12. But this is rarely the case in developing countries.

If we go back to the data presented earlier, we can recall that the unit cost for basic education is between 10 and 20 per cent of the value of GNP per capita. The average GNP per capita in the group of forty-seven countries called least developed countries is $350. So the annual unit cost is between $35 and $70. For such a range of costs, a pupil has access to about 800 hours of face-to-face time with a teacher. The per hour/per pupil cost is therefore below $0. 1, a very small amount if compared with the $1.7 implied by the use of NICT. NICT need to present very attractive comparative advantages in order to justify such a gap in relative costs. NICT have a highly different cost-effectiveness ratio in rich and poor countries.

Of course, it is possible to identify specific activities, linked with the running of basic education systems, which require more expensive training through face-to-face techniques, and for which potentially cost-effective utilisation of NICT may be justified. Such opportunities may be found in fields like the training of high-level specialists for national functions, the training of supervisors, counsellors,

headmasters etc. Here the hourly cost should be compared with the cost of teaching not grade one or two pupils, but graduate or postgraduate students, which can be very different. But it has to be assessed on a case-by-case basis, and no general a priori rule can be provided.

Finally, NICT can be utilised for basic education in developing countries which have already covered part of the road towards development. If we assume a cost of $1.7 per hour for NICT, such a cost is equivalent to face-to-face learning when the unit cost per pupil approaches this level. Based on a unit cost equivalent to 20 per cent of GNP, and on a school year of 800 hours,

the break-even point is reached with a unit cost of $(800 x 1.7) = $1,460, corresponding to a GNP of $ 7,3 00 per capita. Several Latin American countries, such as Argentina, Uruguay and Chile, or transition countries, such as the Czech Republic, Slovenia, Hungary and Croatia, will soon enter this break-even zone.

Conclusion

In spite of the rapid introduction of NICT in educational systems internationally, the great majority of learning hours are still based on face-to-face techniques. This method is characterised by very different costs among countries, from less than $0.1 per pupil/hour in some least developed countries to about $10 in developed ones. This makes a variability range of 1 to 100. The variability of the cost of learning for one hour with a computer is much smaller, because the technology is indeed a 'world' technology, with similar costs everywhere, whatever the local tabour costs. This unit cost can be estimated at $1.7 per pupil. The issue of the effectiveness of learning through a teacher compared with a computer is still highly disputed, and the best assumption one can make is that one hour of teaming in both cases generates on average the same educational outcome.

In this context, it is easy to understand that the substitution of teachers by computers is more likely to succeed, from an economic point of view, in places where the cost of face-to-face is above $1.7 per pupil/hour, than in places where the cost of face-to-face learning is significantly below this threshold. If computers are used in a country where face-to-face teaching costs $0.85, this implies that learning with a computer has to be twice as efficient as learning with a teacher. The lower the cost per pupil/hour with face-to-face teaching, the less likely it is that NICT can be a cost-effective alternative to traditional teaching.

Notes

1. The definition of developed and least developed countries is drawn from World Bank categories, as presented in the annual World Development Report. Developed countries refer to a group of industrialised market economies that is almost identical to the OECD membership. Least developed countries are the group of countries in which the GDP per capita is below a threshold that is adjusted every year in order to take inflation into account.
2. Data on private expenditure are collected by OECD for its members, and the 85 per cent mentioned above for the share of public expenditure is drawn from this database (OECD 1998). For developing countries, one has only partial evidence from country-specific case studies that indicates a greater

variability between countries than is the case with OECD ones. Private finance in this group does not differ significantly from the developed world model, but is probably

slightly above (1520 per cent instead of 15 per cent, Orivel 1995). For these countries, there is also a third source of funding, which is foreign assistance to education. But the volume of foreign assistance does not significantly affect the level of domestic resources, as it represents only about 2-3 per cent of total education expenditure. There is some speculation concerning the impact of recent moves towards debt cancellation in providing additional resources to education systems in least developed countries. Here again, one should not overestimate the impact of this measure. It is not fresh money, but mostly a reduction of budget deficits. A large proportion of this forgiven debt was not actually paid by debtor countries, and the amount of resources represented by this policy will be far below the present flow of external assistance to education.

3 The most common argument in support of this thesis can be found in Hanushek (1994), which shows a great variability of resources spent per student for a given level of education outcomes, other things being equal. Expensive educational institutions have no incentive to reduce costs, and they don't.

4 Educational Resources Information Centre of the United States Department of Education.

These school assistants are recruited in the framework of an employment scheme designed for increasing job opportunities for young French graduates who are unemployed. They have a five-year contract, in principle not renewable, and are paid close to the minimum salary.

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