Information Technologies and Performance Of Higher Education and Training Systems: A Comparison Between Canada and OECD Countries

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Abstract

This study shows that the access rate of the Canadian university system (56%) is one of the highest in the OECD countries. This good quantitative performance however is not accompanied by a similar qualitative performance in science graduation if we consider that the relative share of science graduates (25%) in total university graduates is below those observed in traditional areas (humanities and social sciences). For computer sciences graduates, the relative share still remains low (4%) in all the OECD countries. For these computerized countries, this paradox is then explained. For the Canadian continuing training system, the weakness observable in the quantitative performance (participation rate) is accompanied by a qualitative weakness considering that annual duration of training is two times inferior to the OECD average (31hours versus 64). To reduce the performance gaps between the higher education system and the training system, a couple of measures are presented to improve the integration between these two systems. These interventions are considered for universities, for companies and at the government level.

Sommaire

Cette étude montre que le taux d'accés au système universitaire canadien (56%) est un des plus élevés dans les pays de l'OCDE. Cette bonne performance quantitative n'est cependant pas accompagnée par une performance qualitative similaire pour les diplômes délivrés en science si l'on considère que la part relative de ces diplômes (25%) dans le total des diplômes universitaires est inferieure à celles observées dans les disciplines traditionnelles (humanités et sciences sociales). Pour les diplômés en informatique, la part relative reste faible (4%) dans tous les pays de l'OCDE. Pour ces pays informatisés, ce paradoxe est alors expliqué. Pour le système canadien de formation, la faiblesse observable dans la performance quantitative (taux de participation) est accompagnée par une faiblesse qualitative étant donné que la durée annuelle de formation est deux fois inférieure à celle de l'OCDE (31heures versus 64). Pour réduire les écarts de performance entre le système d'enseignement supérieur et le système de formation, un ensemble d'actions sont proposées pour améliorer l'intégration entre ces deux systèmes. Ces interventions concernent les universités, les compagnies et le gouvernement.

1.0 Introduction

According to the Organization for Economic Co-operation and Development [1], Canada ranks among the first ten countries in the world having invested the most in information and communication technologies. The purpose of this study is to analyse the impact of this massive investment on the access rate and the graduation rate of higher education, particularly in science, as well as to analyse the effects of these technologies on the participation rate to continuous training activities and the quality of these. In conclusion, we will present some elements of an integration strategy between higher education system and training system in order to reduce the performance gaps between these two systems.

2.0 Quantitative Performance Of Both Systems In 1999

The following observations can be drawn from Table 1:

- Canada allocates a considerable financial effort to the development of its university system. This expense equates to more than half (58%) of the Gross Domestic Product (GDP) per capita. This important investment places Canada 4th among the 30 OECD countries for financing of higher education.
- The university enrolment rate is an indicator of accessibility at this strategic education level because, according to a canadian government study [3], 70% of all new jobs in 2004 will require a post-secondary diploma of which 25% will require a university degree. An important result of the enrolment rate is that in all OECD countries, higher education is no longer an elitist education for a minority but a mass education which reaches nearly half (45%) of the population of age to enter university. In Canada, it is more than half of this population (56%) that has access to higher education. This result confirms the forecasts of many specialists [4].
- The indicator that represents the human capital growth gives the pace of progression to the accessibility to higher education. This indicator will also serve as the potential for the future highly qualified labour force. There again, Canada has a high progression rate of 6.9%, which places it 4th in the OECD.
- However, these good performances of the higher education system have not been gained due to its training system that ranked 15th and 16th, below the average of OECD countries. The gap between a very accessible higher education system and a more restrained training system shows an integration problem between these two systems and leads to an inefficient use of human capital. Moreover, this gap presents a paradox if we consider that Canada ranked 5th in importance of hardware/software investment in information technology whereas the training activities only represent 1-2% of Canadian companies sales figures according to Statistics Canada [5].

3.0 Qualitative Performance Of Both Systems In 1999

In Table 2, the resources indicators (expenses and enrolments) previously examined are now accompanied with the result indicators (graduates and duration of training) in order to evaluate the quality of the production of knowledge, particularly scientific and technological knowledge.

The following observations can be drawn from the qualitative performance table:

- The indicators of the graduation rate at the three levels of higher education represent the production rate of the highest levels of knowledge. Canada's position is above the OECD average for the first university level (Bachelor) but falls below the average for the Master's and Ph.D. levels. Consequently, a high entry ratio (quantity indicator) does not go hand in hand with a high rate of graduation (quality indicator).
- The indicators of graduation rate in science are productivity indicators because the scientific and technical areas constitute the modern economy's locomotive. Pertaining to this point, we observe a paradox in all OECD countries if we consider that for these computerized countries only one out of four graduates (23% to 26%) has a scientific background whereas the majority of graduates (two out of three) have traditional backgrounds (33% in humanities, arts and education; 34% in social sciences, commerce and law). In Canada, the relative share of these science graduates is inferior to the OECD average for university programs of three or more years duration (21.5% versus 26.3%). However, it is superior to this average for short university programs (two years) giving direct access to the labour market (26% versus 23%). For computer science graduates, the relative share of graduates still remains low (3% to 4%).
- There are three factors that could be considered to explain this paradox: first, the high level of dropouts and failures in university studies in science. Second, the required skills in information technology are no longer simply technical but also include management skills, oral and written communication skills and the ability to solve complex problems and work in heterogeneous teams. Thirdly, there

Table 1: Quantitative Performance Of Both Systems In 1999

Quantitative performance indicators	Value of the indicator for Canada	Average value of the indicator for OECD	Canada's rank among 30 OECD countries	Top ranked country in OECD
Expenditure per university student	$14 579	$9 063	3	USA ($19 802)
Expenditure per university student in relation to GDP per capita	58 %	44 %	4	USA, Sweden and Switzerland (61 %)
Enrolment rate in higher education (*)	56 %	45 %	6	New-Zealand (71 %)
Growth of working age (25-64) population with an university attainment (1989-1996)	6.9 %	4.2	4	Ireland (7.8 %)
Participation rate of working age population with university attainment in job related training	33 %	46 %	15	United Kingdom and Denmark (70 %)
Participation rate of working age population with university attainment in all continuous training activities (**)	43 %	58 %	18	United Kingdom and Denmark (75 %)

Notes:

(*)Enrolment rate = number of enrolments for an age group divided by the population in that age group.

(**) These activities include on-job-training, certification given by a company or an organisation, training courses and workshops.

Sources: Table established from OECD [1] and OECD [2] data.

seems to be no systematic link between information technology training and the available positions in this field. For example, in the United-Kingdom [4], nearly half of the people occupying positions in information technology do not hold a degree in this field. On that same note, more than half of those who have received education and training in information technology occupy positions that are not linked to these technologies. The most typical case is that of a computer engineer occupying the position of administrative manager. The electronic commerce field is also a good example of the association of technical and commercial skills.

Finally, in terms of the effectiveness of the continuing training system, the indicators tables show that the weakness observable in the quantitative performance (participation rate) is accompanied by a qualitative weakness considering that the annual duration of training is clearly inferior to the OECD average, in particular for the salaried graduates for whom the hours received in training for each year are two times inferior to the OECD average (31 hours versus 64 hours).Therefore, The problem of quantitative integration also involves a qualitative integration problem between the higher education and training systems. These gaps often cause labour shortages. According to the Information Technology Canadian Association, Canada had produced about 8000 graduates in computer science and engineering in 2001 whereas the demand was twice as high in these fields. To reduce the performance gaps between these two systems, we will present in our conclusion a couple of elements of an integration strategy for these systems.

4.0 Conclusion: Integration Strategy Elements Between A Higher Education System And A Training System.

a) The following measures could be considered for universities:

- Using the potential of high-speed networks (ex. Internet 2) for long distance education of information technologies for basic courses in all education programs and not only in computer science, for all students and teachers.
- Strengthening of the partnership between universities and the industry to better sensitize students, during their on-job-training, to methods of working used within companies.
- Increase the participation rate of women in university computer science programs.

b) The following measures could improve the training system effectiveness for companies:

- Increase access to computers and to the Internet in all work locations and for all employees (ex. GM, Ford, Intel, American Airlines programmes and the likes).
- Favour qualified staff retention measures by offering salary based and non-salary based incentives (training programs, career profiles, flexible schedules, benefits sharing, etc.).
- Solve short-term labour shortages by making a more frequent use of certification offered by companies such as Microsoft, Cisco, Novell, Oracle, etc.
- In the long term, favour software outsourcing for small and medium highly specialized companies.

c) The following interventions could be considered at government level:

- Create more organisms working in concert with the industry (ex. Office of partnerships for advanced skills) that could respond to the needs of industry in terms of qualified personnel and sensitize universities to IT training.
- Offer fiscal incentives to companies for their training programs.
- Contribute to short-term problems of labour shortages by facilitating granting of visas and work permits in immigration policies.
- Participate in the establishment of international norms on information technology skills.

Table 2: Qualitative Performance Of Both Systems In 1999

Qualitative performance indicators	Value of the indicator for Canada	Average value of the indicator for OECD	Canada's rank among 30 OECD countries	Top ranked country in OECD
Graduation rate in first degree university programmes (*)	42 %	36 %	8	Japan (59 %)
Graduation rate in second degree university programmes (Master)	4.7 %	5.4 %	12	Poland (18.2 %)
Graduation rate for Ph.D.	0.8 %	1.0 %	12	Switzerland (2.6 %)
Science graduates as a % of total graduates (3 years and more university programmes)	21.5 %	26.3 %	20	Korea (42 %)
Science graduates as a % of total graduates (2 years university programmes)	26 %	23 %	10	Korea (45 %)
Computer science graduates as a % of total university graduates.	3.5 %	3.2 %	11	Ireland (9.5 %)
Number of years spent at university level	2.8	2.5	7	Finland (3.9 %)
Annual training hours per participant with a university degree	94 hours	129 hours	14	New-Zealand (258 h)
Annual training hours per employee with a university degree	31 hours	64 hours	15	New-Zealand (161 h)

Notes:

(*) Graduation rate = number of graduation for a given age group divided by the population in that age group.

Sources: Table established from OECD [1] and OECD [2] data.

5.0 Bibliography

[1]. OECD: "Information technology Outlook". Annual report. Paris. 2002.

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[3]. Human Resources Development Canada: "Knowledge matters: skills and learning for Canadians". Ottawa. 2002.

[4]. S.Brown: "The university" in "Handbook on information technologies for education and training" Springer. New-York. 2002.

[5]. Statistics Canada. Catalog no: 93-332. Ottawa.1999.

About the author

Hadj Benyahia is a Professor in the Computer Science Department of the University of Quebec at Montreal since 1983. He has a "Doctorat d'Etat" from the University of Paris.

He was formerly a project manager and consultant at Gamma Institute specializing in evaluation of new information technologies.

His present research fields are economics of computers, software engineering economics and office automation. He has published many books, reports and articles in these research areas.

Life Members Activities

In May of this year the Hamilton Section formed a Life Member Chapter, with Bert de Kat acting as Chair. The next meeting of this Chapter will be a luncheon on October15th, at the Plainsman Restaurant with a discussion of the Decew Falls Milestone Project.

The Montreal Section Life Member Chapter plan to hold their first meeting on Thursday October 9th., at12:30 in Room A 480, at École Polytechnique. Art Yelon is organizing this inaugural meeting. To get the Chapter Life Members actively involved, discussions are planned on a possible milestone project. Lunch will be available for those who reserve in advance. To reserve, please contact Ron Potts, LM Chapter Co-ordinator R7, at r.potts@ieee.org. If you don't have e-mail, call (514) 340-4711 x 4751.

Activités Des Membres À Vie

En mai dernier, la Section de Hamilton a formé une chapitre; Bert de Kat est Président intérimaire. La prochaine réunion du chapitre sera un lunch, le 15 octobre au Plainsman Restaurant avec une discussion du Projet Decew Falls Milestone.

La première réinion du chapitre des membres à vie de la Section de Montréal est prévu pour le jeudi, 9 octobre à 12h 30, dans la salle A 480 de l'Ecole Polytechnique. Cette réunion inaugurale est organisé par Art Yelon. Pour inciter les membres à vie du chapitre de s'impliquer, on envisage des discussion sur un projet 'Milestone'. Un lunch sera disponible pour ceux qui réservent à l'avance. Pour votre réservation veuillez contacter Ron Potts, r.potts@ieee.org. Ceux qui ne disposent pas de courriel peuvent télephoner à (514) 340-4711 poste 4751.