OECD/Hungary Workshop

Budapest, Hungary, 12-13 June 2003

PROMOTING EQUITY THROUGH ICT IN EDUCATION: PROJECTS, PROBLEMS, PROSPECTS

Andrea Kárpáti, Editor

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

HUNGARIAN MINISTRY OF EDUCATION

2004

A KÖTETET TERVEZTE:
Gyergyák Bence

NYOMDAI ELŐKÉSZÍTÉS, KIVITELEZÉS:
Eurotronik Rt.
e-print Magyarország Rt.

CONTENTS

PROMOTING EQUITY THROUGH ICT IN EDUCATION

Real walls down – Virtual Walls Up? An Introduction.
Bálint MAGYAR, Minister of Education, Hungary 5

ICT and low achievers: What does PISA tell us?
Richard SWEET and Alina MEATES, OECD 13

USING ICT TO IMPROVE THE EDUCATIONAL OUTCOMES OF LOW ACHIEVEING STUDENTS. WHAT DOES THE RESEARCH TELL US?

Promoting equity through ICT: What can international assessments contribute to help fight low achievement?
Hans PELGRUM, University of Twente, the Netherlands 56

E-Learning as a means of promoting educational equity in rural and remote communities: a Canadian case study.
Gerald GALWAY, Newfoundland Department of Education, Canada 70

USING ICT TO IMPROVE THE EDUCATIONAL OUTCOMES OF LOW-ACHIEVING STUDENTS. WHAT TYPES OF POLICIES DO SCHOOLS AND EDUCATION SYSTEMS ADOPT?

Everyone should know the basics: Equalizing opportunities and outcomes for disadvantaged youths through ICT in education,
Tony WILHELM, Benton Foundation, USA 81

Conscious ICT policy as a strategy to promote equity in school.
Liisa ILOMAKI, University of Helsinki, Finland 97

ICT policies adopted for low achieving students in Korea.
Myung-Sook Jeannie PANG, KERIS, South Korea 109

Equity through ICT in education: How the European Commission is meeting the challenge by focusing on good policy practices.
Claire BÉLISLE, ICT Expert Group, European Commission 115

HOW USEFUL CAN ICT BE IN IMPROVING THE QUALITY AND QUANTITY OF EDUCATION FOR SPECIAL GROUPS?

Communities at disadvantage: Reinventing ICT based learning opportunities.
Marcela SANTILLAN, National Pedagogical University, Mexico 124

Travelers in cyberspace: ICT in Hungarian Romani (Gypsy) schools.
Andrea KARPATI, UNESCO Centre for ICT in Education, ELTE, Hungary 141

Information And Communication Technology as a Key Tool For Meeting Special Educational Needs.
Amanda WATKINS, European Agency for the Development in Special Needs Education 157

CONCLUSIONS

ICT in education policies: Some hope for equity
Beatriz Pont, OECD 175

PARTICIPANTS LIST 181

REAL WALLS DOWN – VIRTUAL WALLS UP?

An Introduction

Bálint Magyar, Minister of Education, Hungary

Promoting equity through ICT is one of the most important issues any educational government has to handle while developing computer culture in schools. In order to realise this objective, we need a model of the eLearner of the first decade of the new millennium. This "digital student" is similar and at the same time very different from those we encounter in the classrooms of today. In order to share my vision with You, it must be clarified whom we will teach, what we should teach, how we may teach and in what way policy makers can pave the way of the eLearners, young and old, towards digital literacy.

School laboratories secluded from students, with low performance computers, endless lectures on the history of computing, tedious lessons in programming... a decade ago, Information Technology in public education was modelled after the field of *Informatics*. Many experts are, unfortunately, still convinced, that educational challenges of the Age of Information can be identified with knowledge about hardware, software and applications. The essence of this culture is, however, *digital literacy:* the retrieval, storage, processing and interpretation of digitally transmitted information. Up-to-date ICT tools seek to assist these processes with growing efficacy. These applications communicate more than *information technology* – they share *digital culture.* Therefore, in the focus of teaching about ICT today we find the user, not the *info-specialist*. Basic *user skills* necessary for participating in knowledge – building environments should be at the core of the curriculum.

Rigid, limited knowledge transmitted in the traditional classroom must give way to *flexible, frontier-less knowledge.* ICT culture is democratic – more so than any other innovation that has reached the classroom before computers did. The same way as writing ceased to be the privilege of a small elite group and became the tool of the masses and modern culture based on the written text was born, digital literacy also becomes the daily routine of society with great speed.

Parallel with this process, the way of learning leads from the locality of the classroom towards the flexible and changeable "virtual universe" of networked communities. But have we encountered a real paradigm change in education? Decades after the introduction of computers in schools, the answer should be affirmative. With a flexible, powerful tool to access practically unlimited knowledge areas, how could education have remained more or less the same as it was in the age of black-

board and chalk? Or to formulate it in a more optimistic way: what is the secret of educational success stories, places where eLearners feel at home? Two recent research efforts underline both the needs and potentials for change. In the *OECD study, "ICT and the Quality of Learning" and the SITES2 survey of IEA* (the International Agency for Educational Assessment), primary and secondary schools modelling best practice in computer-supported instruction were selected from all over the world. In these schools, ready questions and ready answers are replaced by problem postulation and problem solution. The *formation of competencies* and attitudes is more important than *instruction in facts.* Learning is a life long process, rather than a closed-up period of childhood unconnected to adult reality. The teacher is no more the dominant source of wisdom – he or she has learnt how to change the role of the "sage on the stage" for the "guide on the side". Learning is flexible – it occurs both formally and informally, often in heterogeneous age groups that solve authentic problems as a knowledge building community. After decades and decades of short-lived reforms, ICT forces *frontal teaching* off the stage. Computer-supported learning environments are best to realise the *constructivist* paradigm: individualised instruction in life skills.

The great chance of ICT culture is that it is not really technology-dependent. During his recent visit to Budapest, Bill Gates remarked that students of today have incomparably better PCs that he himself had when he launched his company. Abilities are key, not gadgets. In the famous experiment by Sugata Mitra, generally nicknamed "*the hole in the wall",* a computer was placed in a niche of a wall of a house situated in a power-stricken area in India. Total novices to ICT culture, it took just a couple of minutes for street kids to get to know the basic functions of the machine and start searching, downloading and playing music from the Internet, playing games, and editing images. As they had no keyboard, they copied and pasted letters from the character map one by one, to write the words, "I love India", on the screen.

For governments, the scope of activities is wider than providing basic access or handing out laptops. Helping the disadvantaged to access ICT is no more a question of social politics – it is an issue of knowledge economy. Traditional pedagogy focuses on verbal and numerical intelligence and leaves relevant for ICT intelligences – for example, flexibility, critical thinking, metacognitive skills – unrecognised. Providing universal access to ICT, we may defeat the global knowledge divide through the educational methods inherent in this emerging culture. ICT acts like a chemical making secret scripts visible: it gives a chance for those traditional schooling leaves behind. In Hungary, we utilise this feature to promote disadvantaged learners from Kindergarten through university level.

e-Tolerance is a secondary school project of the Hungarian Ministry for Information Technology and Mass Communication for our largest minority group, the *Romani* (*Gypsy*) and Hungarian youth. They share the same digitally supported curriculum and get to know each other through lessons of tolerance and empathy. We believe, that the elimination of stereotypical thinking patterns is vital for our adherence to the European Union. In order to integrate successfully, not just our bureaucracy but also our souls must be compatible. In order to increase the social and economic competitiveness of the country, disadvantaged minorities should be given a chance to make use of possibilities of the information society. The Hungarian government supports one of the best secondary grammar schools in the country to launch a *computer-mediated distance education course for members of minority self government bodies.* Participating in this programme, minority politicians acquire Knowledge Society competencies and, at the same time, build a solid knowledge base for further studies.

"Kid-Smart" is an *integrated kindergarten ICT project* aimed at the digital socialisation of children at an early age, through a playful discovery of computer culture. Between 2002-2003, IBM donated 30 PCs developed for use in Hungarian kindergartens. In the course of 2003, our ministry provides

about 500 kindergartens located in disadvantaged areas. The monitoring of the programme is continuously carried out through ability tests and adopted questionnaires used in the British KidSmart Project. Significant development of skills, especially for low ability, socially disadvantaged children was observed. Even less competent youngsters have a holistic concept of the PC. For them, it does not serve as a tool for play only but as a multifunctional, problem solving medium.

As a Hungarian research effort to support the OECD project featured In this publication, *"Promoting Equity Through ICT",* the Ministry of Education commissioned a research and development project from Eötvös University to work out models for teaching learning to learn skills and develop cognitive competencies of Romani students of distant village primary schools. The two-year effort involves mentored teacher training, selection and adaptation of educational software suitable for teenagers with learning difficulties and ICT-supported enrichment programmes in mathematics, physics, chemistry, mother tongue and Information Technology. (Cf. the paper of Andrea Kárpáti in this volume.)

The success stories mentioned above show that ICT actually acts as the Trojan Horse: in the PC box, up-to-date educational methods may be smuggled within the walls of traditional schooling. The expansion of the information society within education should rest on *four pillars:*

1. *Hardware and Software* – provision of suitable infrastructure,
2. *Internet access* – fast, inexpensive, and readily available connectivity,
3. *Skills and competencies,* necessary for making full use of technology and finally,
4. *Content provision,* to communicate current and authentic knowledge.

The further down we go on this list, the more we lag behind – both on a national and on international level. In the European Union, the number of computers per 1000 inhabitants is 400, in Hungary, – 160. The student/computer ratio in Hungary is 30 to 1, while in the EU, 9-12 students per one computer. In order to improve this situation, the *Schoolnet Express Project* was launched in the spring of 2003. This large scale, state-funded project opens the possibility to purchase *ICT equipment tax free.* 120 % of the minimum wage is tax-deductible for purchase of PCs and accessories for teachers, college and university staff members, college and university students, parents of primary, secondary or tertiary level students. Employers (also schools and kindergartens) that purchase PCs or provide Internet access for employees also do it tax-free. More than 1800 outlets around the country offer a selection of 250 types of equipment and 70 software packages and peripheries ranging from scanners to digital cameras. Tax deduction is obtainable for three years, – a measure that renders the leasing of equipment practically free of charge.

We entered the Age of Digital Teaching Aids with a national *software development project* launched this year. It makes high quality digital teaching aids freely available for both students and teachers. We hope to establish an internationally unique *Digital Knowledge Base* that covers the whole of our secondary curriculum. *Expandable and reusable multimedia and interactive tools* in this pool Incorporates all areas of learning. They may be customised and adapted by ICT-oriented teachers to suit their own learning philosophies.

Internet penetration is difficult to estimate correctly. When user numbers per 1000 inhabitants are considered, our figure: 145 is small in comparison to 315, the European average. As for families, percentages are similar. In Hungary, 16 % are connected to the Internet, in the EU, the same figure is 40 %. All Hungarian secondary schools and about one third of primary schools have an Internet connection today – in comparison, 100 % of secondary schools and 91-100 % of primary schools on aver-

age are connected in the European Union. Accessing information is a constitutional right – the information Society makes it a reality. In order to improve our connectivity, massive government efforts have been launched. We intend to increase the number of both public and private Internet access points.

Let me illustrate the characteristics of our endeavours through briefly describing the essential features of the Swedish and Hungarian model for the dispersion of ICT culture. In Sweden, you find no significant differences between the number of computers possessed by university degree holders and blue collar workers. In Hungary, however, the level of education will define if you own a PC or not. *Digital culture, apparently, may increase or decrease social differences and thus bridge or widen the social – cultural – digital divide*. It is our responsibility to solve this burning policy issue. Our tax relief model will hopefully reach about half of our population and double the number of PCs in the homes. If so, we will reach the ownership level of Swedish blue collar workers.

On the Information Superhighway, we need well-trained drivers, and not only technicians. Therefore, the Hungarian ICT curriculum will change its focus from preparing for *informatics* as a profession to training for the use of *digital culture.* At primary level, in Grades 4-6, for age groups 10-12, digital literacy will be taught as an introductory course. Grades 7-9 will learn digital culture and acquire important information processing and communication skills.

We intend *to provoke the teachers.* We have given them a substantial salary raise, tax free PC and state-financed training. Now there are no more excuses, they have to jump in deep water and swim – along with their students. Teachers are often firewalls for change: according to the OECD school based case study project, in 2000, only 25-30 % of teachers at pioneering ICT schools used computers for teaching regularly. If we cannot convince, motivate and train them, the eLearner of 1010 will still be instructed the same way as his or her great great grandparents were.

Digital teaching materials constitute the intellectual infrastructure for the educational reforms initiated by ICT. The Ingenious, know-it-all Textbook Author has to be replaced by emergent and co-operative knowledge builders. Learning in 2010 will certainly be an interactive process, not a one-way alley – through participation in knowledge building communities, elearners will both learn and share their experiences with others. In a more and more globalised community, we need *connected databases of teaching materials* developed in co-operation and shared to increase equity and understanding among cultures. The digital construction of learning materials and databases containing them do not only replace the production and use of traditional textbooks, but also alter the whole infrastructure of the work of the teacher.

ICT should be invited or even forced *to get out of the labs and conquer the classrooms.* To achieve this objective, the Hungarian Schoolnet is currently developing high quality digital teaching materials available for students, teachers and parents through a searchable Internet database. There is no alternative! Teacher training will have to be altered; meta-knowledge, networking capacity and methodology should be in the focus. As an example, we may refer to the Web-encyclopaedias. The ever expanding "blogosphere" includes scientific ventures which, due to their size and complexity, may integrate schools as partners. Such synergies may already be observed in space research, oceanography, and meteorology. We should not believe, however, that these developments make offline publications redundant. These changes inaugurate a new division of labour, with new types of publications. Today, 90 % of materials used at school are traditional, printed textbooks. 7 % is the share of CD-ROMs and DVDs and Internet content occupies only 3 %. These proportions, will be radically altered, perhaps even inverted by 1010.

Herbert Simon claims that the concept of knowledge, which until now was taken as a noun denoting possession, is gradually becoming a noun denoting access. Providing access to state or EU-

financed, high quality educational software may be the chance ICT culture needs for faster progress. It seems natural to consider the redundancy of parallel design, production and testing of new products and investigate the possibilities of sharing, on a non-profit basis the results of huge intellectual and financial investment.

But is sharing a realistic option in this field? Is educational software developed in one culture transferable to another different educational system? International surveys like IEA, PISA and TIMMS, show that there is a significant *common curriculum content*. Educational software does travel well. Software development efforts could be more targeted and efficient if a network of *regional clearinghouses for educational software* was set up to monitor and evaluate products, publicise best practice and catalyse further development in the field. We would like to provide a model for this effort through the establishment of a Centre of Eastern European Educational Software Clearinghouse. It will collect, catalogue, clear for copyright, evaluate, and eventually translate into different languages best examples of digital teaching aids.

We believe, that it is also the interest of the non-profit content provider to reach the broadest audience possible and show, for example, treasures of cultural heritage or achievements of national science. Therefore, we invite You to consider joining this effort. We in Hungary are ready to share.

PROMOTING EQUITY THROUGH ICT IN EDUCATION: PROJECTS, PROBLEMS, PROSPECTS

ICT AND LOW ACHIEVERS: WHAT DOES PISA TELL US?

Richard Sweet and Alina Meates

OECD

INTRODUCTION

Nations wishing to raise overall levels of educational achievement are likely to obtain the greatest returns from raising the performance of the lowest achievers: their potential gains are substantially greater than those whose achievement levels are already high. Raising the achievement levels of the lowest achievers is likely to have economic consequences in addition to equity benefits. There are suggestions that raising the performance of low achievers can result in a compressed skill distribution that allows the productivity of the lowest achievers to be raised, and that this in turn is in turn linked to compressed wage distributions (Nickell and Layard, 1998). The widespread dissemination of ICT within schools in recent years, associated with a belief that ICT can be a powerful tool in improving learning outcomes (OECD, 2001a), focuses policy attention on the role that ICT can play in raising the educational performance of the lowest achievers. The extent to which low achieving students have access to ICT both in school and in the home, and the ways that they use ICT, compared to other students, are important issues for policy. They are important because of the important role that ICT skills play in providing access to good jobs in modern economies (Green, Felstead and Gallie, 2000), because of related concerns about the digital divide (OECD, 2000; Wilhelm, 2003), and because of the intriguing possibilities that are hinted at in papers prepared for this workshop (Pelgrum, 2003; Wilhelm, 2003) and in other literature (North Central Regional Educational Laboratory, 1997) that ICT can be used as a tool to improve the learning skills and the motivation to learn of low achieving students.

While the present state of the art of international comparative assessments may not be able to shed a great deal of light on the question of whether or not ICT can be used to help improve the educational performance of low achievers (Pelgrum, 2003), PISA — the OECD's Programme for International Student Assessment (OECD, 2001b) — does allow considerable light to be shed on access to ICT by low achievers, both at school and in the home, and upon the ways in which low achievers, compared to other students, use ICT. In addition to gathering data on student achievement in literacy, mathematics and science, the first round of PISA data collection in 2000 included a special student computer familiarity questionnaire. Questions that related to ICT availability and use were also included in the main questionnaire completed by all students and in the school question-

naire completed by school principals.[1] Using data from PISA 2000 on the performance of 15 year-olds, this paper provides an initial report of the relationship between literacy achievement levels and access to and patterns of use of ICT. The data elements from the Student Questionnaire (ST), Computer Familiarity Questionnaire (IT) and School Questionnaire (SC) used in the analysis are shown in Appendix 2.

The analysis focused upon eight questions:

1. Are low achievers located in schools with lower or higher ratios of students to computers than are other students?

2. Do low achievers perceive that they have less access to computers at school than other students?

3. Within schools that have few computers, do low achievers seem to gain less access to computers than other students?

4. Are low achievers likely to be located in schools in which principals report that learning is hindered by a lack of computers for instruction?

5. Do low achievers have less access to and make less use of computers at home than other students?

6. Do low achievers have lower interest in computers than other students?

7. Do low achievers report themselves to be less comfortable with and to have less ability in using computers than other students?

8. Do low achievers use computers for different purposes than other students?

THE ANALYSIS

The goals of educational interventions designed to assist low achievers could be thought of in two ways: to assist students who fail to meet objectively defined performance criteria; or to assist students who perform poorly in relation to other students, whatever their objectively measured performance level. Low achievers can be defined a number of ways. Using PISA data, two of these ways are:

- Those who scored at Level 1 and below on the combined reading literacy scale; and

- Those who fell in the bottom quarter of each country's distribution of performance on the combined reading literacy scale.

1. These three questionnaires are referred to in this paper as the IT Questionnaire (IT), the Student Questionnaire (ST), and the School Questionnaire (SC). Copies of each can be found at http://www.pisa.oecd.org/docs.htm.

The first definition results in widely differing proportions of students from each country being defined as low achievers. Appendix 1 shows that the proportion scoring at Level 1 or below ranged from only six per cent in Korea and seven per cent in Finland to 35% in Luxembourg and 44% in Mexico among OECD countries and 56% in Brazil. In countries where the proportion of low achievers is low, using this definition, the reliability of estimates can be reduced as the result of small sample sizes. On the other hand the second definition, whilst it might result in larger samples and hence more reliable estimates, will include quite low proportions of students in the lowest PISA achievement levels in those countries such as Finland and Korea where the overall level of performance is high and variation around the mean is low. Appendix 1 shows that the proportion of students in each country's lowest quartile scoring at Level 1 or below on the combined reading literacy scale ranges from 100% in Luxembourg, Mexico and Portugal to as few as 23% in Korea and 28% in Finland. Whilst in policy terms, as well as statistically, there are arguments in favour of both definitions, this paper reports only the results for low achievement defined in the first way[2,3]: in other words it reports data for students who scored at Level 1 or below on the PISA combined reading literacy scale.

RESULTS[4]

Are low achievers located in schools with lower or higher ratios of students to computers than are other students?

Table 1 in Appendix 3 shows, for the schools in which students at each achievement level are located, the average number of students per computer by achievement level on the PISA combined literacy scale. Within most OECD countries, the relationship between the availability of computers and achievement level does not appear to be very strong: the number of students per computer in the schools in which the weakest students are located generally does not differ greatly from those in which other students are located.

There are some exceptions however. Among OECD countries, in Mexico and Poland, the Czech Republic and France, and in Brazil among non-OECD countries, there is a significant inverse relationship between achievement level and students per computer, with lower achieving students being found in schools with higher numbers of students per computer. In Mexico, for example, the number of students per computer is around six times as high in the schools where the weakest students are found as in the schools containing the most able students (129 compared to 21). And in France the number of students per computer is around 50% greater in schools where the lowest achievers are located than in the schools where the highest achievers are located (15 compared to 10).

In a number of other countries the reverse trend is apparent. In Denmark, the Netherlands, Germany, Korea, Japan, Italy, Portugal and Russia it is the schools in which the lowest achievers are located that have the fewest students per computer. However the extent of the differences is not as extreme as is the case in countries where the lowest achievers' schools have the least computers. Generally the lowest achievers' schools, in these countries, have around one third more computers

2 . This is both for reasons of brevity and because those whose performance is objectively the weakest are likely to be the more important priority for remedial attention within individual schools.
3 . High achievers are defined here as those scoring at Levels 4 and 5 on the combined reading literacy scale.
4 . Tables showing the detailed results of the analysis are given in Appendix 3.

than those of the highest achievers. However in Korea the number is nearly double (11 students per computer compared to 6).

Do low achievers perceive that they have less access to computers at school than other students?

Regardless of the actual number of computers in a school, what do low achievers perceive to be their availability? Three questions in the PISA questionnaires allow this to be explored. The ICT questionnaire asked students both how often a computer is available for them to use in the school, and how often they use a computer at school. The student questionnaire asked students a very similar question, with a slightly different wording, about the frequency with which they used a computers at school. Tables 2.1 to 2.3 report the results of these questions, showing the average combined literacy score of those reporting availability or use at each level of frequency.

Whilst the results of the three questions are not completely consistent, some overall conclusions do seem to be justified. First, it is more common for lower achieving students to report that computers are less available to them than it is for them to report that they use them less. In the Czech Republic, Australia, Canada, the United Kingdom, New Zealand, Latvia, Switzerland, the USA and Luxembourg the average literacy scores of those who report that computers are never or infrequently available to them are significantly lower than the scores of those who report that computers are available to them almost every day or a few times a week. On the other hand in Germany the reverse pattern occurs: the lower achievers are more likely to report that computers are frequently available to them at school. When asked about *use* of computers, lower achieving students in Australia, Austria, the Czech Republic and Mexico are more likely to report less frequent use. However, depending upon which question is analysed, the lowest achievers in Germany, Sweden, Hungary, Liechtenstein and New Zealand are the more likely to report frequent computer use than are the highest achievers.

In a limited number of countries there is a consistent link between the actual number of computers in a school and their perceived availability to and use by low achievers. In Mexico and the Czech Republic low achievers are likely to be in schools with significantly fewer computers than are high achievers, and they are significantly more likely to report that computers are less available to them and that they use them less frequently. In contrast, low achieving students in Germany are more likely to be found in schools with higher numbers of computers, to report that they are more available to them, and that they use them more often. These patterns of results suggest that in these countries there are strong between school effects governing the relationship between computer availability and use.

On the other hand in a country such as Australia, within school factors are the most likely explanation for the link between ICT access and use and achievement levels. Here, the relationship between the actual number of computers in a school and achievement level is not significant, but within schools the lower achieving students report that computers are both less available to them and that they use them less than do high achieving students.

Within schools that have few computers, do low achievers seem to gain less access to computers than other students?

When computers are plentiful, questions of priority in access are less likely to arise than when they are scarce. And so a key policy question is what happens to low achievers when schools have few computers. In each of the PISA 2000 countries, schools were divided into those with the top quarter, middle half, and bottom quarter ratio of students per computer. Within those schools falling in the bottom quarter (those with the fewest computers, or the most students per computer) students' responses to questions on the availability and use of computers at school were examined in relation to achievement level. The results are reported in Tables 3.1 to 3.3.

Whilst, as with the previous analysis across all schools, the results are not completely consistent across each of three questions, some clear patterns do emerge. First, it is much more common for low achievers who are in schools with few computers to report that they do not have computers available to them very frequently than for high achievers, and it is more common for low achievers to report that they do not have computers available to them for use than for them to report that they do not use them very often.

Second, when computers are scarce, there is a consistent pattern in Hungary, the Czech Republic and Russia for the lowest achievers to report the least frequent availability and use. In Germany, on the other hand, the lowest achievers, within schools with the fewest computers, are the most likely to report that they have computers available to them frequently and that they use them frequently. In Luxembourg, Norway and Sweden the lowest achievers in such schools consistently (in both questions on frequency of computer use) report that they use computers the most frequently.

Are low achievers likely to be located in schools in which principals report that learning is hindered by a lack of computers for instruction?

Principals of the schools taking part in PISA 2000 were asked the extent to which learning of 15 year-olds is hindered by a lack of computers. From their responses, a scale was constructed in which "Not at all" = 0, "Very little" = 1, "To some extent"= 2, and "A lot" = 3. Table 4 shows that in Liechtenstein, Mexico, Brazil and France there is a strong tendency for low achievers to be located in schools where principals were most likely to report that a lack of computers hindered instruction. It should be noted that Mexico, Brazil and France are also among the countries in which low achievers are located in schools that have the fewest computers (Table 1).

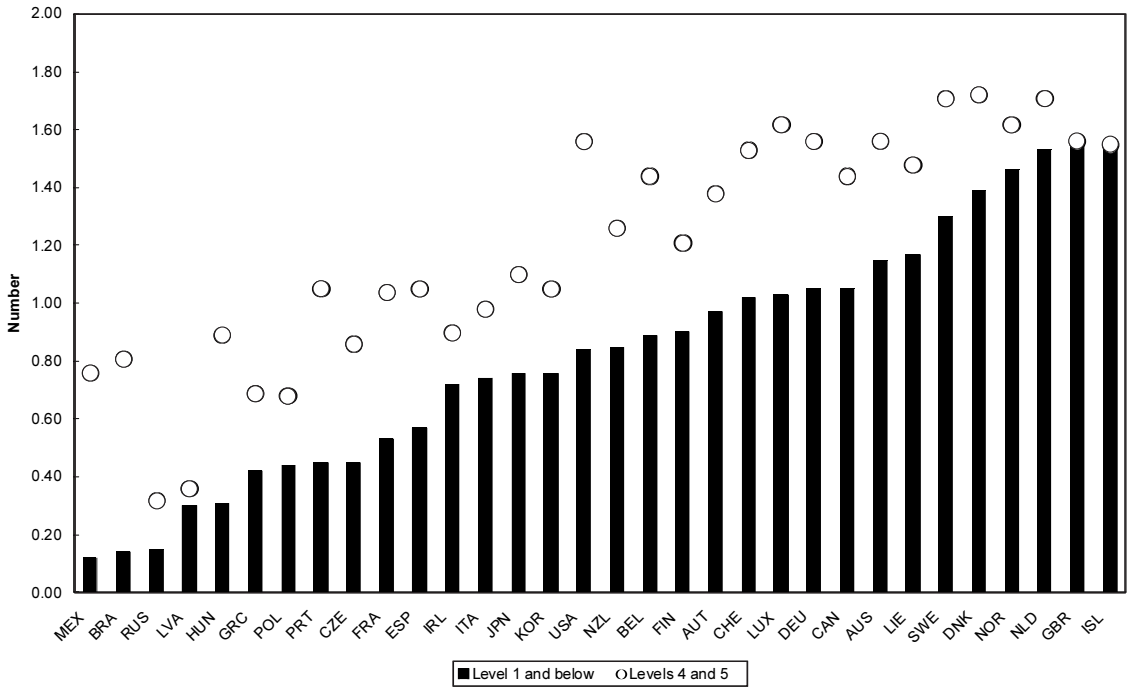
Do low achievers have less access to and make less use of computers at home than other students?

The PISA student questionnaire and ICT questionnaire asked five questions about ICT access and use in the home. The relationship between these and achievement on the combined reading literacy scale is shown in Tables 5.1 to 5.5. While the extent of the relationship is stronger for some of these questions than for others, there is a strong overall trend for the ICT resources available in the home to be significantly less for low achievers than for, in particular, high achievers: the number of computers

in the homes of low achievers is significantly less than in the homes of high achievers in 25 out of the 31 countries that participated in PISA 2000. In the United States, as an example, the average number of computers in the homes of those scoring at Level 1 or below on the combined reading literacy scale is 0.84, compared to 1.56 in the homes of those scoring at Levels 4 and 5, or roughly half as many. In Hungary, there is an average of 0.31 computers in the homes of the lowest achievers, compared to 0.89 in the homes of the highest achievers, or only around one third as many. Figure 1 shows the number of computers in the homes of the lowest and highest achievers for all PISA 2000 countries

Figure 1

Average number of computers in the homes of the lowest and highest achievers



The relationship between Internet access in the home and achievement level is also very strong, being significant in 22 of the 31 countries. In Finland, as an example, only five per cent of low achievers have an Internet link at home, compared to 55% of the highest achievers. In Switzerland, 13% do so, compared to 39% of high achievers. Similarly, the relationship between achievement level and the availability of educational software in the home is very strong, being significant in 22 of the 32 participating countries. In Korea, as an example, only three per cent of the lowest achievers reported having educational software in the home, compared to 41% of the highest achievers. In France, 10% of low achievers have educational software in the home compared to 39% of the highest achievers.

For questions about the availability of computers in the home and about use of computers in the home the relationship with achievement level was not quite as strong, but nevertheless significant in some countries. In Switzerland, Germany, Hungary and the Czech Republic low achievers report that computers are less available to them in the home, and in the United States, Mexico, Australia, Canada, the United Kingdom, Sweden and Russia they report that they use them significantly less in the home than do high achievers.

The very strong relationships observed between achievement level and some indicators of the availability of ICT in the home can be compared to the more modest relationships observed between

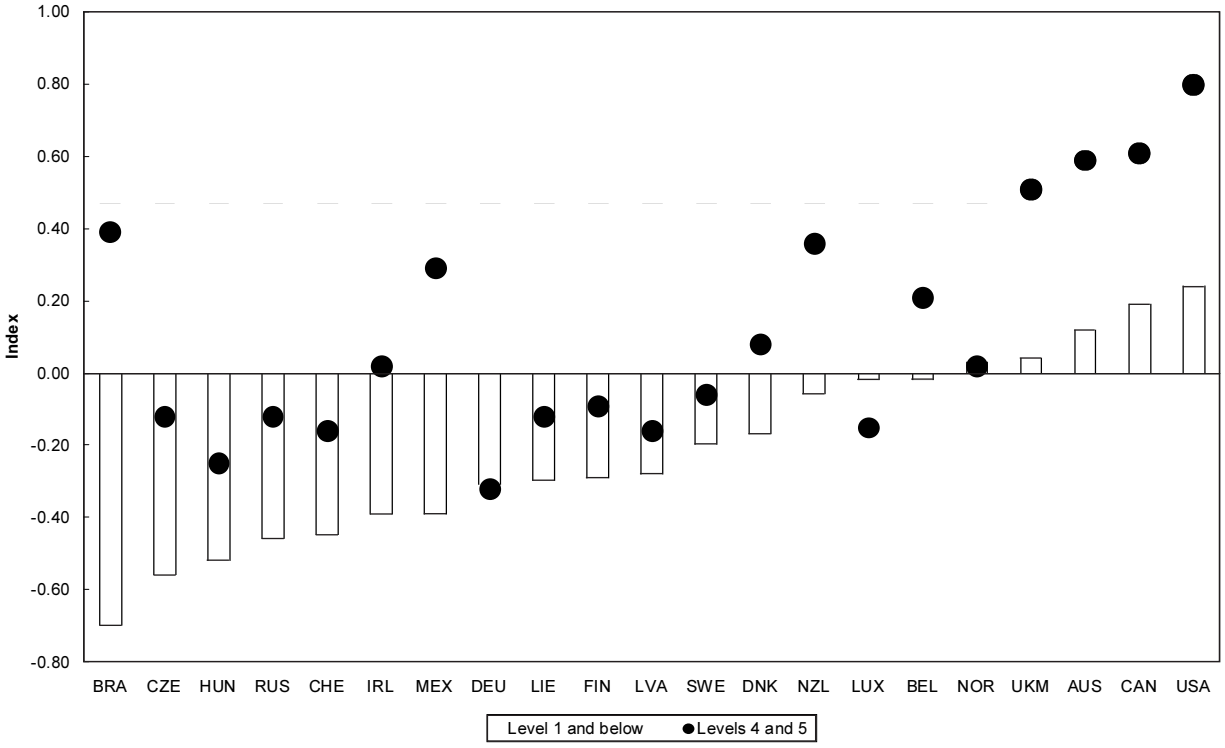
achievement level and the availability of ICT in the school. Results such as these both emphasise the importance of the school as a source of access to ICT by low achievers, and the importance of schools and school systems addressing ways that low achievers can access and use ICT outside of the classroom and outside of normal school hours.

Do low achievers have lower interest in computers than other students?

Table 6 shows the relationship between the PISA index of interest in computers and achievement level on the combined reading literacy scale. It shows that there are no countries taking part in PISA 2000 in which there is any significant relationship between the two variables. In all OECD countries, low achievers seem to be just as interested in computers as other students.

Figure 2

Index[1] of perceived comfort with and ability to use computers



1. The index is standardized to an OECD-wide mean of 0.0 and a standard deviation of 1.0. Values are arranged in order of low achievers' perceived comfort and ability.

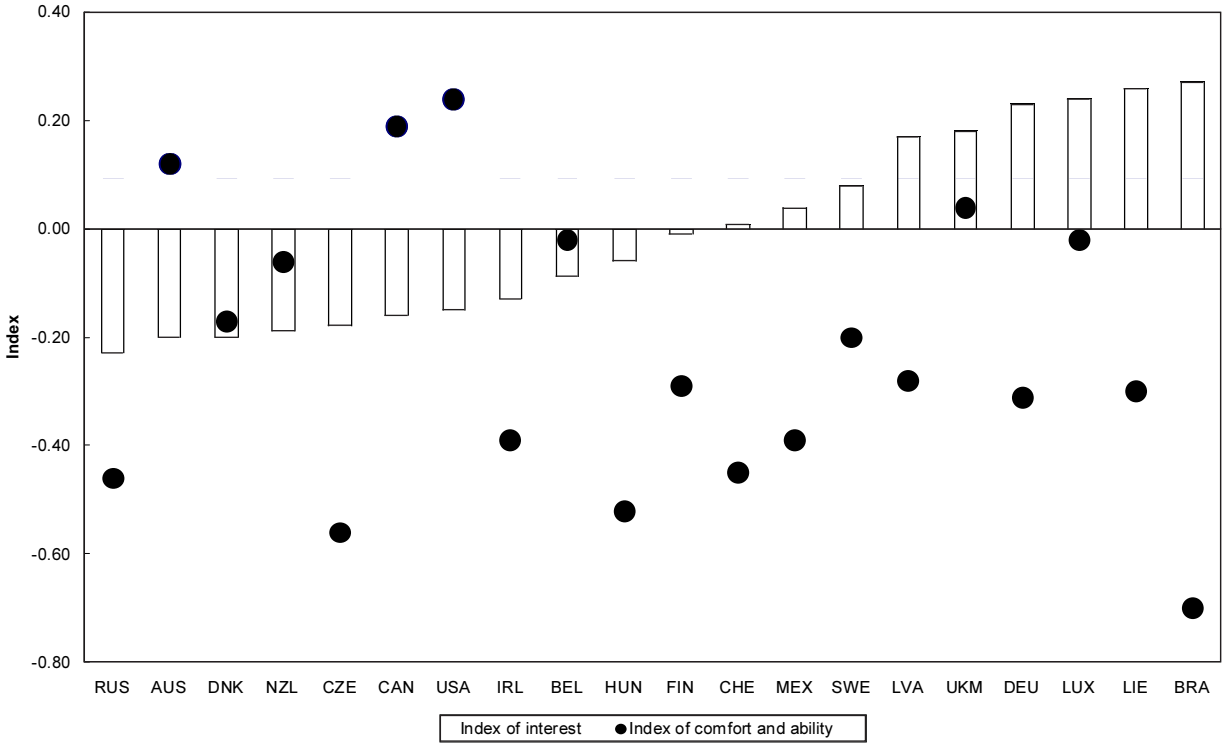
Do low achievers report themselves to be less comfortable with and to have less ability in using computers than other students?

Table 7 and Figure 2 show the relationship between the PISA index of comfort with and perceived ability to use computers and achievement level on the combined reading literacy scale. Whilst there is no significant trend for low achievers to be less interested in computers than other students in PISA 2000 countries, there is a strong trend for them to feel less comfortable using computers than other

students, and to feel that they have less ability in using them than other students. This is apparent in 14 of the 31 PISA 2000 countries, both those where overall comfort with computers is relatively high, such as Australia and the United Kingdom, and those where overall comfort is relatively low, such as Hungary and Switzerland. The only country in which the reverse relationship is found, with low achievers reporting themselves to feel more comfortable and able with computers than other students is Luxembourg, a country in which reported comfort and ability are low for all achievement levels. In Australia, as an example, the index of interest in computers is about the same for low achievers as for high achievers (Table 6). However high achievers report themselves to be around five times more comfortable with and able in using computers than do low achievers. Similarly, in Luxembourg the perceived comfort and ability index is nearly eight times as high among high achievers as among low achievers. And in Germany the two groups feel similarly uncomfortable and lacking in ability to use computers, with both falling below the OECD average.

Figure 3

Low achievers' interest in and perceived comfort with and ability to use computers



The index of interest in computers and the index of perceived comfort with and ability to use computers are both standardised to an OECD-wide mean of 0.0 and a standard deviation of 1.0. values are arranged in order of low achievers' interest in computers.

It is also clear, from Figure 3, that in nearly all OECD countries low achievers' reported level of comfort and ability to use computers is significantly below their reported level of interest in computers. Australia, Canada, Denmark, New Zealand, the United Kingdom and the USA are the only significant exceptions. This is an intriguing finding that might be related to the extent to which English has become the *lingua franca* of common computer software.

Do low achievers use computers for different purposes than other students?

The PISA 2000 Information Technology Questionnaire contains an index of the overall level of use of ICT. In addition, it contains nine specific questions that explore specific aspects of ICT use such as spreadsheets, games, and the Internet. Tables 8.1 to 8.10 show the relationship between achievement on the combined reading literacy scale and both the overall index of use and the nine specific types of ICT use. Table 8.1 shows that the overall level of computer use by low achieving students is, in most of the PISA 2000 countries, not significantly different from that of other students. The exceptions are Sweden, Denmark and Finland, where low achievers use computers significantly more than other students, and Brazil and Russia, where they use them significantly less.

When specific types of computer use are examined, at least some differences are apparent between low achievers and others.

- *Internet use* is more common by higher achievers, and less common by lower achievers, in the United States, Mexico, Australia, Switzerland, Brazil and Canada. The general direction of results is similar in most other countries, although not statistically significant;

- The use of computers for electronic *communication* is less common by low achievers and more common by high achievers in the Mexico, Switzerland, Liechtenstein, Canada and the United Kingdom. The general direction of results is similar in most other countries, although not statistically significant;

- There is a very strong and significant trend – observed in 19 of the 23 countries whose students completed the Computer Familiarity Questionnaire – for the lowest achievers to report that they use computers for programming more often than do high achievers;

- In nearly all countries the general pattern is for low achievers to report that they use computers for games more frequently than do high achievers, although the trend is statistically significant only in the Czech Republic;

- In nearly all countries the general pattern is for high achievers to report that they use computers for word processing more often than do low achievers, but the trend is statistically significant only in Liechtenstein and Mexico;

- In Sweden and Finland low achievers report that they use computers for spreadsheets more often than do high achievers, and there is a similar although not statistically significant pattern in many other countries;

- There is a common pattern in many countries for low achievers to report more frequent use of computers for *drawing and graphics*, although this is statistically significant only in Finland; and

- In four Scandinavian countries (Denmark, Finland, Norway and Sweden) low achievers are more likely than high achievers to report that they use *educational software*. This trend is not significant in other countries, although the pattern is in the same direction in most.

CONCLUSIONS AND POLICY IMPLICATIONS

The analysis that has been reported here carries some messages that are positive. There is, for example, a number of countries whose ICT resourcing practices or policies have resulted in the schools in which low achievers are located having equal levels of ICT resources to those schools in which high achievers are located. And there are many countries in which it seems that the access that low achievers have to ICT within schools differs little from the ICT access that high achievers enjoy. And this same level of equal access for low and high achievers also applies, in some countries, in those schools where computers are relatively scarce.

On the other hand there are some countries in which the schools that low achievers are found in have the lowest level of ICT resources; where, within schools, the lowest achievers receive the least access to ICT; where they receive the least access when computers are scarce; and where school principals feel that the lack of ICT resources hinders the learning of 15-year olds. Many of these problems of low achievers struggling to get access to ICT within schools seem to be more apparent in countries with relatively low levels of GDP, but this is not always the case. Some, although generally not all, of these problems can be seen in relatively wealthy OECD countries such as Australia and France. Certainly the analysis presented here makes it clear that where low achievers do get less access to ICT in school than other students, there are some cases where the problem is primarily a function of the distribution of resources between schools, and other cases where it is largely a function of the ways in which resources are distributed within schools. Each presents quite different challenges for resourcing policies.

There are, in addition, some countries – of which Germany is an example – where low achievers generally enjoy higher access to ICT within schools than other students. Why this is so is not clear from the present analysis. It could be a function of the interaction between the ways in which low achievers are streamed into different types of schools interacting with ICT resourcing policies and with other factors such as policies and programmes for training teachers in ICT use. Or it could be the result of deliberate policies, based upon a belief in the educational benefit of ICT in improving achievement levels, that ICT resources should be concentrated upon those who need them most. Again, the analysis reported here does not shed a great deal of light on this issue. However it could be pointed out in this context that it is in four Scandinavian countries (Denmark, Finland, Norway and Sweden) where low achievers are the most likely, when compared to other students, to use educational software.

It is also not clear, from either the present analysis or other evidence, that the relative concentration of ICT resources upon low achievers should necessarily be a goal of policy. Certainly the importance of ICT skills in modern knowledge-based economies and societies argues that low achievers' access to ICT in order to develop ICT literacy and employment-relevant ICT skills is an important equity issue. However whether relatively greater access is required in order to improve overall levels of achievement is another matter. Evidence presented to this workshop, and elsewhere, hints at the value of ICT for raising achievement levels, but perhaps in policy terms this argues for no more than equal access.

Another positive message from the analysis is that there seems no general or significant trend for low achievers to be less interested in computers than high achievers. There are, however, hints from

the results that they like to use them in different ways (using non-verbal images for example), and there is strong evidence that in many countries they feel far less confident and competent when using computers than do high achievers, and that their level of perceived confidence and competence is far lower than their reported interest. This strongly points to the importance of concerted effort to find ways to better connect low achievers with ICT, or to better engage the interest in ICT that they clearly have. In this context, the finding that low achievers' perceived confidence and competence in using ICT is higher than their reported interest in ICT in English-speaking countries, but that elsewhere the reverse is generally the case, is intriguing. It is open to speculation on the extent to which this is a function of the fact that the dominant language for both the most common operating systems and the more commonly used software is English. If this is part of the reason, it helps to reinforce calls that are commonly made by educators for the availability of more appropriate educational software, and for more educational software to be written in languages other than English.

While the analysis shows that there are inequities within and between schools in the access that low achievers have there to ICT, the more important finding is that, in general, inequities in access and use seem to be far greater in the home than they are in the school. This helps to emphasise the importance of the school in giving low achievers access to ICT. It emphasises the importance of schools and school systems working actively to combat the limited access that low achievers, in many countries, have to ICT in their home: fewer computers; more limited Internet access; and less educational software. There are many examples of programmes that help to do this, and the evidence here constitutes an argument for their continuation and their more careful targeting on low achievers. These include programmes to lend computers to students; after-school access programmes; more targeted use of ICT in school libraries; and the stimulation of community access points that low achievers can easily access. In re-emphasising the key role that schools can play in providing ICT access and ICT skills, and in helping low achievers to use ICT to improve their levels of achievement, the findings help to counteract the common impression that schools do not need to worry about many students' ICT access and skills, because they are thought to pick up these skills and gain this access readily outside of the home. This is clearly not the case for low achieving students in many OECD countries. Pertinent here is recent Norwegian research which shows that many school students are not as able at using ICT as they claim, and that many teachers are far more competent in using ICT than they believe (Ministry of Education and Research, 2002).

Finally, the analysis shows that in the case of low achieving students, the scale of the digital divide varies widely across countries, and that it need not be evidently related either to national wealth or to the ease and cheapness of ICT access. This is particularly the case within the home. For example in the United States it seems to be surprisingly large. There, the gap between the interest in computers of the lowest and the highest achievers is much larger than in all other OECD countries. More significantly, in the United States, low achievers use computers at home far less than do high achievers, have fewer computers in the home, and have less home Internet access.

REFERENCES

FELSTEAD, A., GALLIE, D. AND GREEN, F. (2000)
Computers are even more important than you thought: An analysis of the changing skill-intensity of jobs, *Discussion Paper* No. 439, Centre for Economic Performance, University of London.

MINISTRY OF EDUCATION AND RESEARCH (2002)
Information and communication Technology (ICT) competency among pupils and teachers: A study of the ICT competency among pupils and teachers in Norway and their own evaluation of this, mimeo, Oslo.

NICKELL, S. AND LAYARD, R. (1998)
Labour market institutions and economic performance, *Discussion Paper* No. 407, Centre for Economic Performance, University of London.

NORTH CENTRAL REGIONAL EDUCATIONAL LABORATORY (1997)
Critical Issue: Using Technology to Enhance Engaged Learning for At-Risk Students, http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at400.htm

OECD (2000):
L*earning to Bridge the Digital Divide*, Paris.

OECD (2001a)
Learning to Change: ICT in Schools, Paris.

OECD (2001b)
Learning and Skills for Life: First Results from PISA 2000, Paris.

PELGRUM, W. (2003):
Promoting equity through ICT. What can international assessments contribute to help fight low achievement?, Paper prepared for a joint OECD/Hungary workshop on "Promoting Equity Through ICT in Education: Projects, Problems, Prospects" Budapest, 12-13 June.

WILHELM, A.G. (2003):
Everyone should know the basics: Equalizing opportunities and outcomes for disadvantaged youths through ICT in education", Paper prepared for a joint OECD/Hungary workshop on *Promoting Equity Through ICT in Education*: Projects, Problems, Prospects Budapest, 12-13 June.

APPENDIX 1: TWO WAYS OF DEFINING LOW ACHIEVERS ON THE PISA COMBINED READING LITERACY SCALE

	1. Per cent of all students at Level 1 or below	2. Per cent of students within each national lowest quartile at:				
		Level 1 and below	Level 2	Level 3	Levels 4 and 5	Total
OECD countries						
Australia	12.46	49.73	50.26	0.00	0.00	100.0
Austria	14.62	58.33	41.67	0.00	0.00	100.0
Belgium	18.99	75.88	24.13	0.00	0.00	100.0
Canada	9.56	38.21	61.79	0.00	0.00	100.0
Czech Republic	17.50	69.93	30.07	0.00	0.00	100.0
Denmark	17.91	71.53	28.47	0.00	0.00	100.0
Finland	6.95	27.78	56.95	15.27	0.00	100.0
France	15.19	60.68	39.31	0.00	0.00	100.0
Germany	22.63	90.40	9.60	0.00	0.00	100.0
Greece	24.41	97.56	2.44	0.00	0.00	100.0
Hungary	22.71	90.67	9.33	0.00	0.00	100.0
Iceland	14.53	58.03	41.97	0.00	0.00	100.0
Ireland	11.04	44.10	55.90	0.00	0.00	100.0
Italy	18.92	75.57	24.43	0.00	0.00	100.0
Japan	10.08	40.26	59.74	0.00	0.00	100.0
Korea	5.75	22.94	74.31	2.75	0.00	100.0
Luxembourg	35.07	100.00	0.00	0.00	0.00	100.0
Mexico	44.14	100.00	0.00	0.00	0.00	100.0
Netherlands	n.a.	38.03	61.96	0.00	0.00	100.0
New Zealand	13.70	54.87	45.13	0.00	0.00	100.0
Norway	17.49	69.86	30.14	0.00	0.00	100.0
Poland	23.23	92.88	7.12	0.00	0.00	100.0
Portugal	26.25	100.00	0.00	0.00	0.00	100.0
Spain	16.27	64.99	35.01	0.00	0.00	100.0
Sweden	12.58	50.26	49.73	0.00	0.00	100.0
Switzerland	20.37	81.38	18.62	0.00	0.00	100.0
United Kingdom	12.85	51.31	48.69	0.00	0.00	100.0
United States	17.92	71.53	28.47	0.00	0.00	100.0
OECD average	**17.90**	***65.95***	***35.4***	***0.64***	***0.00***	***100.00***
Non-OECD countries						
Brazil	55.80	100.00	0.00	0.00	0.00	100.0
Latvia	30.56	100.00	0.00	0.00	0.00	100.0
Liechtenstein	22.13	87.63	12.37	0.00	0.00	100.0
Russia	27.42	100.00	0.00	0.00	0.00	100.0

APPENDIX 2: PISA DATA ELEMENTS USED IN THE ANALYSIS

1. Are low achievers located in schools with lower or higher ratios of students to computers than are other students?

By level of proficiency on the combined reading literacy scale:

Ratio of students to computers

2. Do low achievers perceive that they have less access to computers at school than other students?

By level of proficiency on the combined reading literacy scale:

i) "How often is there a computer available for you to use at school?" [IT 1b]

ii) "How often do you use a computer at school?" [IT4b]

iii) "At your school, about how often do you use computers?" [ST39b]

3. Within schools, do low achievers seem to gain less access to computers than other students?

Within schools, divided within each country into the top quartile, middle half and bottom quartile in terms of the number of students per computer, by level of proficiency on the combined reading literacy scale:

i) "How often is there a computer available for you to use at school?" [IT 1b]

ii) "How often do you use a computer at school?" [IT4b]

iii) "At your school, about how often do you use computers?" [ST39b]

4. Are low achievers likely to be located in schools in which principals report that learning is hindered by a lack of computers for instruction?

By level of proficiency on the combined reading literacy scale:

i) "In your school, how much is learning of 15-year-old students hindered by lack of computers for instruction?" [SC11e]

5.Do low achievers have less access to and make less use of computers at home than other students?

By level of proficiency on the combined reading literacy scale:

i) "How often is there a computer available for you to use at home?" [IT1a]

ii) "How often do you use a computer at home?" [IT4a]

iii) "In your home, do you have educational software?, (% yes) [ST21c]

iv) "In your home, do you have a link to the Internet?", (% yes) [ST21d]

v) "How many computers do you have in your home?" [ST22d]

6. Do low achievers have lower interest in computers than other students?

By level of proficiency on the combined reading literacy scale:

Index of interest in computers (COMATT). This index was derived from students' responses to the following statements: It is very important to me to work with a computer; To play or work with a computer is really fun; I use a computer because I am very interested in this; and, I forget the time, when I am working with the computer. It is based on questions IT07, IT08, IT09, and IT10.

7. Do low achievers report themselves to be less comfortable with and to have less ability in using computers than other students?

By level of proficiency on the combined reading literacy scale:

Index of comfort with and perceived ability to use computers (COMAB). This index was derived from students' responses to the following questions: How comfortable are you with using a computer?; How comfortable are you with using a computer to write a paper?; How comfortable are you with taking a test on a computer?; and, If you compare yourself with other 15-year-olds, how would you rate your ability to use a computer? It was based on questions IT02a, IT02b, IT02c, and IT03.

8. Do low achievers use computers for different purposes than other students?

By level of proficiency on the combined reading literacy scale:

i) *Index of computer usage (COMUSE).* This index was derived from students' responses to the questions on the frequency with which they use the computer for the following purposes: to help them learn school material; for programming; for word processing (examples of software packages were given); spreadsheets (examples of software packages were given); drawing, painting or graphics; and, educational software. It was based on questions IT05c, IT05Qd, IT06Qb, IT06Qc, IT06Qc, and IT06Qe.

ii) "How often do you use the Internet?" [IT5a]

iii) "How often do you use a computer for electronic communication?" [IT5b]

iv) "How often do you use the computer to help you learn school material?" [IT5c]

v) "How often do you use the computer for programming?" [IT5d]

vi) "How often do you use games?" [IT6a]

vii) "How often do you use <word processing>?" [IT6b]

viii) "How often do you use <spreadsheets>?" [IT6c]

ix) "How often do you use <drawing, painting or graphics>?" [IT6d]

x) "How often do you use <educational software>?" [IT6e]

APPENDIX 3: STATISTICAL TABLES

1. Number of students per computer by level of proficiency on the combined reading literacy scale
2.1 Availability of computers for use at school by mean score on the combined reading literacy scale
2.2 Frequency with which computers are used at school by mean score on the combined reading literacy scale (1)
2.3 Frequency with which computers are used at school by mean score on the combined reading literacy scale (2)
3.1 Within schools with relatively few computers, the availability of computers by level of proficiency on the combined reading literacy scale
3.2 Within schools with relatively few computers, the frequency with which computers are used by level of proficiency on the combined reading literacy scale (1)
3.2 Within schools with relatively few computers, the frequency with which computers are used by level of proficiency on the combined reading literacy scale (2)
4. Principals' report of the extent to which 15-year-olds' learning is hindered by lack of computers by level of proficiency on the combined reading literacy scale
5.1 Frequency of computer availability in the home by mean score on the combined reading literacy scale
5.2 Frequency of computer use in the home by mean student performance on the combined reading literacy scale
5.3 Availability of educational software in the home by level of proficiency on the combined reading literacy scale
5.4 Availability of an Internet link in the home by level of proficiency on the combined reading literacy scale
5.5 Average number of computers in the home by level of proficiency on the combined reading literacy scale
6. Index of interest in computers by level of proficiency on the combined reading literacy scale
7. Index of perceived comfort with and ability to use computers by level of proficiency on the combined reading literacy scale
8.1 Index of computer usage by level of proficiency on the combined reading literacy scale
8.2 Frequency of Internet use by mean student performance on the combined reading literacy scale
8.3 Frequency of use of computers for electronic communication by mean student performance on the combined reading literacy scale
8.4 Frequency with which computers are used for learning school material by mean student performance on the combined reading literacy scale
8.5 Frequency with which computers are used for programming by mean student performance on the combined reading literacy scale
8.6 Frequency with which computers are used for games by mean student performance on the combined reading literacy scale
8.7 Frequency with which computers are used for word processing by mean student performance on the combined reading literacy scale

8.8 Frequency with which computers are used for spreadsheets by mean student performance on the combined reading literacy scale

8.9 Frequency with which computers are used for drawing, painting or graphics by mean student performance on the combined reading literacy scale

8.10 Frequency with which computers are used for educational software by mean student performance on the combined reading literacy scale

NOTES:

1. Within each table, values are arranged in order of the slope of the line fitted through the points in the header row of the table. The value of the slope is shown in the second column from the right.
2. For each country, the significance of the relationship between student achievement and the variable of concern in the table was tested by fitting a line through the row values and the values in the header row and testing the significance of the difference between the slope of the line and zero. The resulting F values are shown in the far right column of each table. Those significant at at least the five per cent level are shown in bold.

TABLE 1: Number of students per computer by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Brazil	276.18	210.17	138.99	87.79	-63.64	**468.36**
Mexico	128.69	71.22	39.90	21.24	-35.37	**32.43**
Poland	59.89	38.67	29.69	32.46	-9.13	5.79
Czech Republic	33.38	31.27	23.28	17.87	-5.45	**47.17**
France	15.06	13.96	11.52	10.36	-1.65	**79.50**
Hungary	16.18	10.91	10.18	11.40	-1.51	2.09
Latvia	33.06	30.41	30.78	31.39	-0.46	0.71
Austria	11.79	9.70	9.45	10.39	-0.44	0.85
Switzerland	12.88	12.98	12.39	11.82	-0.38	10.34
Luxembourg	10.16	9.35	9.18	9.42	-0.24	2.05
Iceland	11.05	10.97	10.60	10.46	-0.21	**31.76**
New Zealand	6.52	6.65	6.56	6.52	-0.01	0.07
Australia	5.79	6.11	6.06	5.84	0.01	0.01
United Kingdom	7.78	7.90	7.96	8.10	0.10	**96.33**
United States	5.64	5.72	6.03	5.92	0.11	4.39
Norway	6.13	6.58	6.49	6.69	0.16	5.05
Finland	9.31	9.33	9.65	9.76	0.17	18.56
Sweden	10.08	11.51	12.09	11.57	0.51	2.67
Lichtenstein	7.45	6.60	7.39	9.54	0.71	2.21
Ireland	13.69	15.25	15.98	15.98	0.76	9.49
Spain	22.24	23.23	23.43	25.24	0.92	18.56
Denmark	8.42	9.23	10.38	11.23	0.96	**439.54**
Belgium	13.32	12.87	14.49	16.36	1.07	7.63
Netherlands	8.28	9.22	10.33	11.91	1.20	**134.71**
Germany	21.23	23.37	23.92	27.18	1.84	**27.35**
Korea	5.81	7.60	10.21	11.42	1.94	**114.34**
Greece	56.97	54.75	58.08	62.39	1.96	3.28
Japan	10.20	11.81	14.52	16.75	2.24	**226.31**
Italy	12.77	14.46	17.47	19.44	2.30	**177.78**
Portugal	61.64	71.06	81.28	82.77	7.36	**26.74**
Russia	94.08	108.83	118.30	127.33	10.92	**127.57**
Total	36.06	21.60	16.13	14.57	-6.99	11.40
Average	28.86	21.64	18.53	16.49	-4.02	**22.56**

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 2.1: Availability of computers for use at school[1] by mean score on the combindreading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Denmark	510.50	493.07	498.95	492.40	389.24	24.32	4.56
Czech Republic	552.86	520.49	504.64	481.43	462.68	21.94	**236.85**
Australia	544.30	521.79	503.76	499.69	471.70	16.73	**74.08**
Liechtenstein	508.64	481.76	480.64	488.69	435.26	13.98	6.24
Canada	544.84	538.29	520.95	509.33	494.85	12.89	**220.44**
United Kingdom	534.77	528.53	520.14	508.15	486.81	11.63	**46.61**
New Zealand	544.32	532.74	520.81	519.21	493.23	11.57	**36.01**
Latvia	480.90	467.00	474.20	442.22	436.07	11.44	**14.74**
Switzerland	530.12	494.89	487.74	484.94	479.39	11.14	**9.57**
Mexico	433.03	452.05	424.16	438.66	404.47	7.05	1.97
United States	519.38	511.25	512.36	508.13	486.28	6.93	**9.68**
Luxembourg	468.01	460.14	456.44	447.69	443.57	6.13	**203.21**
Hungary	501.29	481.24	476.68	485.76	468.76	6.05	4.97
Belgium	521.25	515.93	534.70	529.46	490.24	4.85	0.73
Brazil	418.21	408.68	418.68	406.61	397.25	4.40	4.65
Russian Federation	445.85	481.59	491.11	459.02	446.89	2.05	0.08
Ireland	526.18	534.58	538.65	526.21	520.86	1.90	0.64
Finland	550.66	545.76	546.74	559.58	536.04	1.54	0.27
Sweden	515.01	517.51	521.04	522.83	506.37	1.20	0.28
Germany	475.11	487.73	492.60	511.06	504.52	-8.22	**16.23**
Total	514.92	501.37	500.78	501.34	459.76	11.04	6.85
Average	523.64	507.39	504.60	506.22	473.62	10.12	**10.35**

1. “How often is there a computer available for you to use at school?”, [IT1b]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 2.2: Frequency with which computers are used at school[1] by mean score on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Czech Republic	521.84	520.02	515.19	484.85	476.02	12.68	**20.04**
Denmark	494.18	498.86	517.25	505.08	443.45	9.52	1.18
Mexico	429.25	458.93	437.53	445.17	405.36	6.15	0.94
Australia	532.74	527.24	538.54	531.71	513.97	3.31	1.42
Latvia	442.53	471.97	476.67	448.21	443.09	2.26	0.15
Canada	529.71	531.75	542.22	543.34	526.53	-0.52	0.04
Russian Federation	430.11	484.25	491.90	456.13	447.85	-0.74	0.01
United Kingdom	520.56	524.00	538.22	540.48	520.44	-1.62	0.22
United States	501.73	496.54	532.61	529.71	497.27	-2.43	0.14
Ireland	507.06	531.28	538.13	527.42	525.66	-3.33	0.79
Switzerland	477.47	485.09	506.32	499.88	494.33	-4.85	2.40
Hungary	469.78	481.46	484.49	481.18	497.32	-5.48	**10.32**
Finland	527.89	542.47	552.91	566.96	545.45	-5.96	2.29
New Zealand	519.66	514.82	540.72	549.52	535.24	-6.59	3.20
Luxembourg	427.01	453.39	467.18	460.57	462.06	-7.73	4.33
Sweden	493.09	509.48	529.03	530.98	527.28	-8.99	**9.27**
Brazil	367.65	365.71	431.13	417.77	399.00	-11.48	1.86
Belgium	451.16	502.56	539.89	534.40	508.03	-14.56	2.23
Norway	446.54	488.12	521.08	525.29	501.26	-14.66	3.44
Liechtenstein	464.16	451.81	490.25	520.87	502.99	-14.67	6.36
Germany	444.07	473.70	493.35	514.41	507.13	-16.68	**19.31**
Total	497.05	493.54	520.68	523.10	470.40	2.37	0.09
Average	497.43	502.60	519.46	523.36	489.83	-0.56	0.01

1. "How often do you use a computer at school?", [IT4b]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 2.3: Frequency with which computers are used at school[1] by variation in student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Liechtenstein	473.02	472.02	495.20	488.33	525.26	-12.08	**10.35**
Sweden	502.02	515.07	528.13	537.13	531.58	-8.12	**13.79**
Germany	479.35	483.13	479.03	499.37	508.70	-7.49	**10.74**
New Zealand	520.08	519.82	534.88	548.15	542.06	-7.23	**11.77**
Norway	479.55	512.11	516.69	519.86	509.57	-6.78	2.36
Greece	460.75	478.89	461.62	469.50	495.16	-5.94	2.28
Finland	540.72	545.82	545.01	560.28	554.00	-4.10	6.44
Italy	474.97	501.94	480.72	487.64	501.69	-3.91	1.04
France	496.70	514.18	504.17	513.16	513.62	-3.28	2.48
Japan	518.11	513.40	525.47	528.16	526.54	-3.16	5.07
United Kingdom	517.69	530.05	531.56	542.11	524.97	-2.66	0.84
Korea	519.59	533.03	518.07	532.72	527.86	-1.62	0.45
Portugal	465.73	476.08	471.99	474.73	472.96	-1.31	1.10
Canada	537.28	527.88	536.45	541.30	532.77	-0.44	0.06
Switzerland	494.71	501.88	491.71	494.22	497.60	0.19	0.02
Luxembourg	448.17	460.19	442.35	439.11	456.66	0.41	0.02
Belgium	500.05	537.13	506.73	514.84	498.74	2.49	0.20
Hungary	483.88	488.08	461.01	472.85	477.93	2.71	0.60
Iceland	505.92	519.69	502.30	515.35	488.31	3.96	1.06
Australia	537.23	525.18	528.53	523.84	517.59	4.06	**11.66**
Ireland	532.67	541.37	515.43	514.83	525.48	4.09	1.44
Austria	514.48	509.81	505.85	500.20	496.96	4.47	**603.91**
Spain	508.62	514.76	521.92	512.93	486.00	4.71	1.27
Brazil	510.97	504.99	485.31	496.01	481.86	6.72	8.09
Latvia	417.20	438.90	405.10	407.23	394.71	7.67	3.32
Netherlands	476.76	478.62	446.15	455.32	443.87	8.91	7.73
Czech Republic	541.44	554.60	540.62	526.77	507.25	9.62	7.59
Russian Federation	520.89	522.31	496.83	490.26	477.77	11.83	**34.70**
Poland	489.53	497.62	455.61	458.95	449.59	11.85	8.71
Denmark	495.15	514.95	482.95	454.75	451.75	14.70	8.83
Mexico	498.86	503.83	502.27	497.89	421.42	16.08	3.14
United States	463.95	461.52	446.30	430.32	397.18	16.47	**28.11**
Total	505.37	510.29	510.75	508.06	491.59	2.98	1.65
Average	504.02	511.14	506.25	507.80	493.37	2.46	1.50

1. "At your school, about how often do you use computers?", ST39b

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 3.1: Within schools with relatively few computers[5], the availability of computers[1] by level of proficiency on the combined reading literacy scale (Mean index in which "Never or hardly ever" = 0, "A few times a year" = 1, "About once a month" = 2, "Several times a month" = 3, "Several times a week" = 4)

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Germany	1.85	1.81	1.64	1.56	-0.10	**38.35**
Sweden	3.10	3.05	3.04	3.07	-0.01	0.63
Latvia	2.25	2.22	2.38	2.27	0.02	0.40
Liechtenstein	2.35	2.77	2.81	2.41	0.02	0.03
Finland	2.77	2.75	2.96	2.91	0.06	3.25
Luxembourg	2.27	2.45	2.53	2.51	0.08	6.40
Belgium	2.06	2.05	2.33	2.27	0.09	4.05
United States	2.79	3.05	3.19	3.09	0.10	3.27
Mexico	2.64	2.61	2.76	2.94	0.11	9.07
Ireland	1.84	1.80	2.04	2.15	0.12	9.76
Russian Federation	1.63	1.63	1.85	1.96	0.12	17.29
United Kingdom	2.86	3.05	3.18	3.30	0.15	**155.74**
Australia	3.20	3.37	3.55	3.64	0.15	**107.14**
Denmark	3.15	3.36	3.52	3.60	0.15	**53.40**
Switzerland	2.45	2.39	2.60	2.97	0.18	6.69
Hungary	2.55	2.79	2.95	3.13	0.19	**257.86**
Brazil	1.63	1.83	1.91	2.25	0.19	**31.05**
New Zealand	2.78	3.01	3.23	3.40	0.21	**441.47**
Czech Republic	1.54	2.10	2.51	2.85	0.43	**151.66**
Total	2.78	2.92	3.12	3.15	0.13	**30.27**
Average	2.68	2.83	2.99	3.15	0.16	**8.216.33**

1. "How often is there a computer available for you to use at school?" [IT1b]

$F_{.05}$=19.25; $F_{.01}$=99.25

5. Defined as schools falling within the top students per computer quartile within each country.

TABLE 3.2: Within schools with relatively few computers[6], the frequency with which computers are used at school1 by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Luxembourg	2.27	2.11	1.92	1.68	-0.20	**237.14**
Sweden	2.81	2.69	2.44	2.30	-0.18	**106.32**
Norway	2.48	2.20	2.07	1.95	-0.17	**40.09**
Germany	1.74	1.68	1.54	1.49	-0.09	**53.88**
United States	2.32	2.25	2.19	2.10	-0.07	**288.00**
Switzerland	2.10	1.90	1.90	1.89	-0.06	3.53
Brazil	1.27	1.33	1.20	1.17	-0.04	2.97
New Zealand	2.24	2.28	2.29	2.14	-0.03	0.85
Finland	2.46	2.51	2.56	2.48	0.01	0.24
Liechtenstein	2.21	2.34	2.27	2.28	0.01	0.26
Latvia	2.08	2.05	2.21	2.09	0.02	0.28
Denmark	2.92	2.93	3.03	2.96	0.02	0.97
Australia	2.53	2.63	2.63	2.62	0.03	2.13
United Kingdom	2.35	2.51	2.58	2.44	0.03	0.50
Ireland	1.55	1.51	1.56	1.68	0.04	3.02
Belgium	2.01	2.01	2.27	2.15	0.07	1.92
Mexico	2.25	2.17	2.34	2.47	0.08	4.52
Russian Federation	1.47	1.52	1.78	1.84	0.14	**22.26**
Hungary	2.46	2.66	2.82	2.99	0.18	**875.00**
Czech Republic	1.39	1.86	2.18	2.35	0.32	**45.51**
Total	2.26	2.20	2.26	2.23	0.00	0.04
Average	2.29	2.29	2.33	2.23	-0.01	0.48

(Mean index in which "Never or hardly ever" = 0, "A few times a year" = 1, "About once a month" = 2, "Several times a month" = 3, "Several times a week" = 4)

1. "How often do you use a computer at school?" [IT4b]

$F_{.05}$=19.25; $F_{.01}$=99.25

6. Defined as schools falling within the top students per computer quartile within each country.

TABLE 3.3: Within schools with relatively few computers[7], the frequency with which computers are used at school1 by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Sweden	1.33	1.19	0.94	0.85	-0.17	**66.89**
Luxembourg	2.15	1.97	1.79	1.71	-0.15	**75.00**
Portugal	2.51	2.25	2.11	2.08	-0.14	15.46
Norway	1.65	1.49	1.44	1.27	-0.12	**53.04**
Liechtenstein	1.46	1.21	1.11	1.18	-0.09	3.45
Germany	2.19	2.13	1.93	1.95	-0.09	10.48
New Zealand	1.65	1.53	1.42	1.52	-0.05	1.77
United Kingdom	1.10	1.02	0.92	1.04	-0.03	0.61
Greece	1.90	1.83	1.71	1.85	-0.03	0.46
Switzerland	1.69	1.79	1.72	1.67	-0.01	0.23
Finland	1.17	1.09	1.12	1.17	0.00	0.02
Italy	1.01	0.87	0.85	1.06	0.01	0.05
Brazil	2.32	2.40	2.21	2.43	0.01	0.07
Iceland	1.16	1.17	1.14	1.24	0.02	1.27
France	2.32	2.34	2.08	2.50	0.03	0.09
Australia	0.95	1.02	0.91	1.15	0.05	1.13
United States	1.50	1.31	1.31	1.75	0.08	0.55
Latvia	1.85	1.74	1.94	2.04	0.08	3.05
Netherlands	1.83	2.04	1.85	2.16	0.08	1.49
Denmark	0.63	0.58	0.76	0.88	0.09	7.57
Ireland	2.01	2.17	2.21	2.37	0.11	**43.56**
Austria	0.64	0.86	0.80	1.08	0.13	7.89
Japan	1.97	2.22	2.11	2.47	0.14	5.16
Belgium	1.32	1.25	1.53	2.01	0.24	7.20
Mexico	1.08	1.33	1.60	1.80	0.24	**573.29**
Korea	0.74	0.77	1.00	1.50	0.25	11.36
Poland	1.04	1.08	1.19	1.86	0.26	5.94
Spain	1.97	2.15	2.42	2.75	0.26	**120.14**
Russian Federation	1.93	2.17	2.55	2.74	0.28	**130.08**
Hungary	0.53	0.72	0.99	1.40	0.29	**67.54**
Czech Republic	1.33	1.60	2.08	2.73	0.47	**60.54**
Total	1.43	1.44	1.48	1.67	0.08	6.55
Average	1.37	1.29	1.32	1.50	0.04	1.04

"At your school, about how often do you use computers?" [SC39b]

$F_{.05}$=19.25; $F_{.01}$=99.25

7. Defined as schools falling within the top students per computer quartile within each country.

TABLE 4: Principals' report of the extent to which 15 year-olds' learning is hindered by lack of computers[1] by level of proficiency on the combined reading literacy scale (Mean index) [2]

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Liechtenstein	1.77	1.38	0.82	0.80	-0.35	**20.26**
Mexico	2.27	1.88	1.61	1.25	-0.33	**456.33**
Brazil	1.95	1.72	1.44	1.14	-0.27	**578.28**
France	1.17	1.05	0.89	0.79	-0.13	**281.67**
United Kingdom	1.69	1.65	1.62	1.45	-0.07	10.51
Germany	1.55	1.52	1.42	1.37	-0.06	**49.95**
Russian Federation	2.39	2.34	2.27	2.20	-0.06	**341.33**
Japan	1.18	1.09	1.03	1.00	-0.06	**40.00**
Norway	1.70	1.58	1.56	1.53	-0.05	10.68
Spain	0.99	0.94	0.95	0.81	-0.05	6.64
Iceland	1.34	1.23	1.20	1.21	-0.04	4.79
Sweden	1.51	1.42	1.39	1.38	-0.04	10.50
Australia	1.09	1.03	0.98	0.97	-0.04	**25.09**
Czech Republic	1.15	1.12	1.07	1.05	-0.03	**81.67**
United States	0.94	0.94	0.89	0.86	-0.03	17.89
Latvia	1.30	1.37	1.29	1.23	-0.03	1.48
New Zealand	1.25	1.27	1.22	1.18	-0.03	5.54
Switzerland	0.94	0.84	0.82	0.86	-0.03	1.37
Netherlands	1.28	1.36	1.23	1.24	-0.03	0.85
Austria	1.30	1.24	1.23	1.22	-0.03	8.33
Hungary	0.53	0.45	0.37	0.48	-0.02	0.49
Canada	1.05	1.03	1.01	1.00	-0.02	**96.33**
Luxembourg	1.06	0.92	0.95	1.00	-0.01	0.22
Greece	1.85	1.85	1.87	1.82	-0.01	0.48
Portugal	1.23	1.17	1.18	1.22	0.00	0.02
Poland	1.14	1.20	1.19	1.16	0.01	0.12
Denmark	0.98	1.03	1.02	1.01	0.01	0.59
Belgium	0.68	0.68	0.73	0.76	0.03	17.89
Finland	1.25	1.35	1.34	1.36	0.03	3.97
Italy	0.89	0.93	0.98	1.01	0.04	**240.14**
Ireland	1.04	1.23	1.21	1.20	0.05	1.70
Korea	0.80	0.94	0.97	0.99	0.06	8.78
Total	1.38	1.20	1.09	1.03	-0.116	**37.17**
Average	1.26	1.17	1.13	1.11	-0.049	18.91

1. "In your school, how much is learning of 15-year-old students hindered by lack of computers for instruction?" [SC11e]

2. The table shows the mean values of an index constructed from principals 'responses, in which "Not at all" = 0, "Very little" = 1, "To some extent" = 2, "A lot" = 3.

$F_{.05}$=19.25; $F_{.01}$=99.25

Table 5.1: Frequency of computer availability in the home by mean score on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Liechtenstein	506.59	403.54	449.2	325.44	423.52	24.424	1.54
Switzerland	512.61	471.39	467.97	428.53	428.63	21.082	**28.11**
Belgium	540.36	481.14	475.79	448	462.57	18.872	7.54
Denmark	514.57	459.02	458.41	447.75	446.97	14.647	6.35
Germany	509.93	484.73	465.12	466.77	447.5	14.282	**31.15**
United States	529.79	443.72	426.61	438.18	461.27	14.258	1.30
Australia	537.92	504.33	472.62	493.91	473.37	13.952	6.20
Brazil	447.81	380.07	367.51	375.82	390.41	11.905	1.57
Luxembourg	471.85	428.5	420.73	412.4	421.13	11.754	4.9
Hungary	511.26	488.35	489.33	483.61	456.47	11.432	**17.40**
Mexico	473.51	395.29	364.97	406.28	414.27	10.749	0.67
United Kingdom	544.38	475.63	435.71	490.18	485.98	10.225	0.62
New Zealand	550.63	468.01	489.42	502.26	482.43	10.215	1.06
Canada	545.41	492.76	490.87	503.79	491.54	9.671	2.28
Czech Republic	520.89	493.9	500.41	483.96	483.71	8.43	**9.39**
Sweden	522.06	480.72	471.93	499.16	471.94	8.18	1.70
Russian Federation	496.58	442.89	450.51	438.43	464.32	6.898	0.83
Finland	557.52	516.73	510.48	521.35	526.43	5.756	0.98
Ireland	541.69	496.99	525.53	518.84	508.24	4.505	0.64
Latvia	474.47	445.65	431.82	452	462.25	1.809	0.10
Total	525.45	456.99	441.34	452.87	441.27	17.248	4.45
Average	526.44	473.03	468.41	467.41	461.45	13.56	5.51

"How often is there a computer available for you to use at home?" [IT1a]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 5.2: Frequency of computer use in the home by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
United States	530.24	518.31	507.42	469.23	457.41	-19.47	**53.51**
Switzerland	509.42	504.93	509.70	485.92	431.86	-17.41	6.79
Mexico	478.08	465.66	414.47	426.66	411.97	-17.12	**11.13**
Australia	538.77	539.91	531.33	503.55	471.39	-17.11	**16.36**
Liechtenstein	494.65	484.45	516.61	480.02	417.56	-15.86	2.56
Belgium	526.46	534.73	541.08	514.01	459.20	-15.52	3.79
New Zealand	541.73	550.52	549.25	516.53	488.21	-14.10	6.90
Canada	545.41	541.24	540.75	515.07	490.89	-13.52	**15.75**
United Kingdom	539.63	541.01	537.47	516.73	486.12	-13.13	**10.80**
Denmark	508.82	507.80	507.62	495.15	453.15	-12.40	6.34
Brazil	448.11	412.48	443.87	410.64	389.28	-11.95	4.22
Sweden	521.24	521.61	520.87	496.98	474.46	-11.82	**11.30**
Germany	501.78	512.63	510.20	508.58	446.80	-11.40	2.18
Norway	509.91	520.46	516.26	497.80	466.15	-11.02	5.24
Hungary	503.10	513.78	513.59	508.09	455.50	-10.09	2.17
Russian Federation	493.66	482.88	464.73	457.17	464.14	-8.48	**10.64**
Luxembourg	463.63	459.56	464.88	453.43	429.30	-7.48	5.73
Czech Republic	512.24	523.05	527.15	513.67	483.47	-6.69	1.86
Ireland	535.35	542.52	542.80	528.61	509.65	-6.53	3.96
Finland	552.83	557.69	553.44	552.54	525.88	-5.91	3.41
Latvia	464.77	487.93	438.64	471.19	462.32	-2.16	0.12
Total	524.23	517.87	509.95	486.26	439.01	-20.20	**16.81**
Average	520.03	523.40	520.21	502.66	461.48	-13.78	7.18

"How often do you use a computer at home?" [IT4a]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 5.3: Availability of educational software in the home by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Finland	5.66	14.13	29.65	50.56	15.02	**58.12**
Korea	3.39	16.12	39.22	41.27	13.67	**24.01**
Canada	8.00	16.62	27.99	47.38	12.95	**55.20**
Netherlands	8.74	16.27	30.08	44.91	12.23	**101.74**
New Zealand	10.74	15.86	24.90	48.50	12.23	16.44
Japan	8.58	16.51	30.96	43.94	12.05	**151.84**
Ireland	9.40	16.40	28.87	45.33	12.03	**64.33**
Belgium	12.04	14.88	27.95	45.12	11.23	**23.70**
Australia	10.75	18.31	26.06	44.89	11.02	**32.21**
United Kingdom	10.54	18.50	27.27	43.69	10.82	**57.89**
France	9.84	19.30	31.83	39.02	10.01	**207.56**
Sweden	11.94	20.44	31.02	36.60	8.46	**154.17**
United States	14.11	19.25	28.70	37.94	8.09	**125.41**
Hungary	11.65	20.66	33.65	34.04	8.02	**19.88**
Norway	14.78	18.20	29.69	37.33	7.91	**54.20**
Austria	12.64	20.56	31.81	35.00	7.83	**50.79**
Iceland	12.40	20.85	32.24	34.51	7.77	**35.91**
Czech Republic	12.05	21.93	33.37	32.64	7.32	14.27
Spain	11.79	23.12	34.03	31.05	6.87	7.83
Poland	17.17	19.40	30.33	33.10	5.87	**24.14**
Greece	16.17	21.54	30.93	31.36	5.50	**20.80**
Portugal	15.94	21.66	31.56	30.84	5.46	13.98
Russian Federation	15.59	23.63	31.17	29.62	4.96	9.23
Denmark	17.03	22.56	29.74	30.68	4.81	**27.64**
Italy	15.85	24.08	31.60	28.46	4.53	5.52
Switzerland	18.75	21.18	29.36	30.70	4.40	**23.58**
Germany	19.25	22.16	27.90	30.69	4.01	**95.87**
Liechtenstein	22.15	21.81	28.28	27.75	2.33	5.67
Mexico	20.26	29.33	33.52	16.88	-0.60	0.02
Latvia	28.49	21.00	28.00	22.50	-1.10	0.32
Luxembourg	28.78	27.77	27.95	15.50	-3.97	3.72
Brazil	33.12	32.78	23.29	10.81	-7.64	15.07
Total	12.94	19.62	29.97	37.47	8.39	**307.20**
Average	13.00	19.67	30.07	37.27	8.32	**280.15**

"In your home, do you have educational software?" (% yes) [IT22d]

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 5.4: Availability of an Internet link in the home by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Finland	5.09	11.97	27.84	55.10	16.59	**26.43**
Netherlands	6.98	14.89	28.02	50.11	14.25	**39.85**
Ireland	6.75	14.93	28.71	49.62	14.24	**49.90**
Japan	6.48	14.45	31.90	47.17	13.95	**96.75**
Canada	7.46	15.76	27.37	49.41	13.75	**37.99**
New Zealand	9.18	14.93	24.35	51.54	13.65	14.92
Belgium	10.07	13.19	26.19	50.55	13.44	16.10
Korea	3.94	16.34	38.56	41.17	13.39	**26.66**
France	8.25	15.21	29.62	46.92	13.04	**61.25**
United Kingdom	8.53	16.58	26.47	48.42	12.96	**31.36**
Australia	9.10	16.57	25.08	49.24	12.89	**20.70**
Austria	10.48	18.42	30.60	40.49	10.22	**338.89**
United States	11.64	18.11	29.10	41.15	9.95	**118.15**
Sweden	10.69	19.15	30.93	39.23	9.74	**409.19**
Spain	10.22	20.27	32.66	36.85	9.23	**60.23**
Switzerland	12.50	18.77	29.76	38.97	9.04	**191.23**
Czech Republic	11.61	20.36	29.30	38.73	9.03	**6789.42**
Portugal	14.11	18.79	30.45	36.65	7.93	**75.59**
Norway	15.30	18.28	28.12	38.30	7.88	**41.20**
Hungary	13.61	19.98	30.31	36.10	7.78	**163.74**
Germany	15.67	19.07	27.74	37.51	7.42	**49.98**
Iceland	13.21	21.05	31.64	34.11	7.33	**40.95**
Liechtenstein	14.56	19.49	32.63	33.32	6.94	18.65
Denmark	14.88	21.62	29.95	33.55	6.43	**92.77**
Italy	14.89	21.74	31.16	32.21	6.14	**26.17**
Poland	22.12	18.45	27.70	31.72	3.81	4.63
Greece	21.24	22.71	28.86	27.19	2.40	5.60
Russian Federation	20.60	24.39	27.97	27.05	2.29	8.13
Mexico	21.44	27.98	31.86	18.71	-0.43	0.02
Luxembourg	23.39	27.73	30.84	18.04	-1.29	0.20
Latvia	30.16	19.61	27.84	22.40	-1.51	0.38
Brazil	31.98	30.98	23.94	13.11	-6.37	16.60
Total	10.71	17.64	29.75	41.89	10.57	**137.60**
Average	11.45	18.14	29.37	41.04	10.00	**142.03**

"In your home, do you have a link to the Internet?" (% yes) [ST21d]

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 5.5: Average number of computers in the home by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
United States	0.84	1.06	1.29	1.56	0.24	**852.55**
Brazil	0.14	0.30	0.49	0.81	0.22	**70.14**
Mexico	0.12	0.28	0.51	0.76	0.22	**215.00**
Portugal	0.45	0.60	0.83	1.05	0.20	**252.82**
Luxembourg	1.03	1.30	1.47	1.62	0.19	**96.01**
Hungary	0.31	0.54	0.69	0.89	0.19	**333.84**
Belgium	0.89	1.09	1.25	1.44	0.18	**1,213.37**
France	0.53	0.66	0.85	1.04	0.17	**273.93**
Switzerland	1.02	1.26	1.43	1.53	0.17	**58.98**
Germany	1.05	1.29	1.38	1.56	0.16	**69.43**
Spain	0.57	0.71	0.86	1.05	0.16	**377.33**
New Zealand	0.85	0.95	1.09	1.26	0.14	**152.59**
Australia	1.15	1.26	1.39	1.56	0.14	**201.04**
Czech Republic	0.45	0.56	0.69	0.86	0.14	**201.04**
Austria	0.97	1.19	1.31	1.38	0.14	**31.70**
Sweden	1.30	1.48	1.58	1.71	0.13	**143.81**
Canada	1.05	1.15	1.26	1.44	0.13	**92.04**
Japan	0.76	0.89	0.98	1.10	0.11	**456.33**
Liechtenstein	1.17	1.29	1.47	1.48	0.11	**21.73**
Denmark	1.39	1.49	1.56	1.72	0.11	**69.36**
Finland	0.90	1.03	1.12	1.21	0.10	**216.75**
Korea	0.76	0.90	0.99	1.05	0.10	**56.89**
Greece	0.42	0.48	0.56	0.69	0.09	**62.37**
Poland	0.44	0.45	0.54	0.68	0.08	15.37
Italy	0.74	0.81	0.88	0.98	0.08	**231.15**
Russian Federation	0.15	0.17	0.21	0.32	0.06	14.07
Norway	1.46	1.48	1.53	1.62	0.05	**22.84**
Ireland	0.72	0.78	0.76	0.90	0.05	6.04
Netherlands	1.53	1.65	1.58	1.71	0.05	2.90
Latvia	0.30	0.25	0.32	0.36	0.03	1.98
United Kingdom	1.55	1.50	1.48	1.56	0.00	0.00
Iceland	1.56	1.52	1.56	1.55	0.00	0.01
Total	0.68	0.89	1.07	1.30	0.20	**990.86**
Average	0.79	0.96	1.11	1.29	0.17	**1,815.00**

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 6: Index of interest in computers (mean index), by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Finland	-0.01	-0.04	-0.07	-0.24	-0.07	8.82
New Zealand	-0.19	-0.24	-0.22	-0.34	-0.04	5.39
Hungary	-0.06	0.09	0.04	-0.17	-0.04	0.44
Denmark	-0.20	-0.17	-0.24	-0.29	-0.03	4.98
United Kingdom	0.18	0.19	0.19	0.08	-0.03	2.20
Sweden	0.08	0.15	0.08	0.01	-0.03	1.33
Liechtenstein	0.26	0.12	0.18	0.15	-0.03	1.01
Germany	0.23	0.31	0.29	0.16	-0.02	0.48
Australia	-0.20	-0.15	-0.18	-0.26	-0.02	1.03
Switzerland	0.01	0.17	0.13	-0.03	-0.02	0.10
Luxembourg	0.24	0.33	0.31	0.25	0.00	0.00
Belgium	-0.09	0.06	0.05	-0.03	0.02	0.21
Canada	-0.16	-0.09	-0.06	-0.09	0.02	2.29
Czech Republic	-0.18	0.00	0.06	-0.10	0.03	0.31
Latvia	0.17	0.38	0.39	0.31	0.04	0.85
Ireland	-0.13	0.00	0.03	0.01	0.05	3.52
Brazil	0.27	0.44	0.48	0.42	0.05	1.81
Mexico	0.04	0.40	0.48	0.47	0.14	5.21
United States	-0.15	0.23	0.42	0.44	0.20	11.85
Russian Federation	-0.23	0.21	0.36	0.47	0.23	16.68
Total	-0.02	0.21	0.28	0.22	0.08	2.96
Average	-0.02	0.08	0.05	-0.08	-0.02	0.33

All results are standardised to an OECD-wide mean of 0.0 and a standard deviation of 1.0.

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 7: Index of perceived comfort with and ability to use computers by achievement level on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
Luxembourg	-0.02	-0.09	-0.13	-0.15	-0.04	**29.35**
Germany	-0.31	-0.30	-0.28	-0.32	0.00	0.01
Norway	0.03	-0.06	-0.02	0.02	0.00	0.00
Latvia	-0.28	-0.23	-0.16	-0.16	0.04	17.95
Sweden	-0.20	-0.13	-0.06	-0.06	0.05	16.33
Finland	-0.29	-0.19	-0.11	-0.09	0.07	**27.52**
Liechtenstein	-0.30	-0.39	-0.25	-0.12	0.07	3.09
Belgium	-0.02	0.14	0.15	0.21	0.07	10.89
Denmark	-0.17	-0.14	-0.06	0.08	0.08	**22.74**
Hungary	-0.52	-0.36	-0.27	-0.25	0.09	16.53
Switzerland	-0.45	-0.28	-0.21	-0.16	0.09	**22.54**
Russian Federation	-0.46	-0.33	-0.28	-0.12	0.11	**56.40**
Ireland	-0.39	-0.28	-0.17	0.02	0.13	**93.52**
Canada	0.19	0.36	0.49	0.61	0.14	**288.37**
New Zealand	-0.06	0.10	0.27	0.36	0.14	**125.45**
Czech Republic	-0.56	-0.41	-0.28	-0.12	0.15	**1,401.67**
United Kingdom	0.04	0.27	0.40	0.51	0.15	**60.50**
Australia	0.12	0.26	0.46	0.59	0.16	**297.94**
United States	0.24	0.49	0.67	0.80	0.19	**95.57**
Mexico	-0.39	-0.22	0.11	0.29	0.24	**116.29**
Brazil	-0.70	-0.41	-0.13	0.39	0.36	**77.08**
Total	-0.11	0.12	0.34	0.48	0.20	**174.45**
Average	-0.21	-0.09	0.02	0.14	0.12	**6,728.00**

All results are standardised to an OECD-wide mean of 0.0 and a standard deviation of 1.0.

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 8.1: Index of computer usage (mean), by level of proficiency on the combined reading literacy scale

	Level 1 & below	Level 2	Level 3	Levels 4 & 5	Slope	F
New Zealand	0.41	0.39	0.29	0.10	-0.10	14.67
Norway	0.08	-0.18	-0.19	-0.22	-0.09	4.91
Sweden	0.14	0.11	0.02	-0.12	-0.09	**24.98**
Luxembourg	0.28	0.12	0.08	0.03	-0.08	16.13
United States	0.47	0.51	0.43	0.27	-0.07	4.59
Denmark	0.19	0.10	0.05	0.00	-0.06	**80.08**
Finland	-0.08	-0.10	-0.18	-0.24	-0.06	**43.56**
United Kingdom	0.43	0.41	0.40	0.28	-0.05	6.57
Germany	0.06	0.14	0.14	-0.05	-0.03	0.58
Belgium	-0.08	-0.06	-0.06	-0.18	-0.03	1.67
Ireland	0.03	0.00	0.00	-0.02	-0.02	15.00
Australia	0.25	0.31	0.29	0.21	-0.01	0.40
Canada	0.06	0.00	0.01	0.02	-0.01	0.82
Liechtenstein	-0.24	-0.21	-0.10	-0.28	0.00	0.00
Switzerland	-0.26	-0.21	-0.19	-0.25	0.00	0.08
Latvia	-0.22	-0.23	-0.07	-0.12	0.05	2.78
Hungary	-0.23	0.03	0.07	0.02	0.08	2.51
Czech Republic	-0.56	-0.33	-0.17	-0.13	0.15	**22.98**
Brazil	-0.31	0.10	0.11	0.26	0.17	9.40
Russian Federation	-1.02	-0.67	-0.36	-0.09	0.31	**600.63**
Mexico	-0.70	-0.05	0.30	0.46	0.38	**24.19**
Total	-0.04	0.23	0.26	0.15	0.06	0.98
Average	-0.04	0.04	0.04	-0.03	0.00	0.02

All results are standardised to an OECD-wide mean of 0.0 and a standard deviation of 1.0.

$F_{.05}$=19.25; $F_{.01}$=99.25

TABLE 8.2: Frequency of Internet use1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
United States	524.80	532.03	520.35	502.97	426.00	-22.67	6.44
Mexico	478.99	473.66	464.07	458.02	415.35	-14.29	**12.28**
Australia	537.93	539.16	537.85	512.54	483.21	-13.61	**10.24**
Norway	513.48	510.95	523.35	506.09	448.18	-13.55	3.18
Hungary	505.89	505.55	508.91	494.83	445.22	-13.21	4.69
Switzerland	520.67	514.76	508.84	486.18	469.30	-13.13	**39.13**
Sweden	518.57	520.45	526.95	512.s99	464.03	-11.65	3.33
Czech Republic	523.03	532.59	536.49	511.69	477.04	-11.29	3.80
Brazil	444.22	440.37	427.19	429.77	395.30	-10.84	**11.33**
Finland	556.85	546.87	553.42	552.17	501.04	-10.63	3.31
Canada	541.94	536.95	538.17	520.59	498.12	-10.40	**13.50**
Denmark	502.92	501.72	517.04	504.60	454.18	-9.46	1.85
New Zealand	541.37	540.51	553.18	528.31	502.86	-8.92	3.58
Liechtenstein	492.40	482.01	491.05	492.29	449.84	-7.48	2.19
Germany	513.91	513.01	514.84	505.38	481.00	-7.35	5.88
United Kingdom	538.26	542.13	540.79	537.52	503.96	-7.32	3.23
Belgium	529.55	535.04	546.90	533.53	496.39	-6.78	1.41
Luxembourg	463.56	460.61	472.37	457.65	431.34	-6.74	2.74
Ireland	549.97	537.64	552.44	537.07	520.49	-5.95	3.62
Russian Federation	455.18	500.40	510.67	498.61	475.13	3.81	0.23
Latvia	447.37	474.89	493.55	488.39	461.49	4.17	0.41
Total	524.65	524.85	518.44	502.27	449.96	-17.20	8.56
Average	523.47	521.48	526.10	510.01	470.67	-11.71	5.50

1. “How often do you use the Internet?” [IT5a]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.3: Frequency of use of computers for electronic communication1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
United States	529.91	528.66	516.44	522.54	466.41	-13.31	5.15
Mexico	476.63	475.31	455.96	453.13	424.29	-12.69	**24.48**
Czech Republic	530.40	533.73	536.18	507.09	488.37	-11.07	7.40
Switzerland	524.31	517.98	512.65	503.36	477.50	-10.82	**21.44**
Hungary	510.75	509.40	507.98	499.66	464.62	-10.20	6.68
Liechtenstein	511.07	485.04	491.70	480.43	466.92	-9.29	**13.74**
Brazil	446.63	434.14	429.82	433.88	403.10	-8.73	8.51
Australia	537.77	541.43	538.92	537.68	498.30	-8.27	3.17
Canada	545.93	540.78	537.62	529.53	511.12	-8.09	**22.86**
Finland	562.90	550.34	551.68	551.94	523.89	-7.64	6.91
Sweden	522.09	517.42	532.52	521.30	482.86	-7.46	1.90
United Kingdom	549.43	540.07	541.03	537.95	515.04	-7.09	**9.41**
New Zealand	550.16	539.41	545.97	543.05	514.44	-6.78	4.15
Norway	514.48	513.35	519.45	525.56	475.86	-6.50	1.15
Belgium	540.89	534.55	542.74	539.99	506.87	-6.26	2.35
Denmark	507.63	505.20	516.51	512.40	474.74	-5.86	1.37
Ireland	553.16	542.69	551.30	544.18	525.56	-5.37	4.59
Germany	512.54	512.63	516.55	518.18	486.41	-4.67	1.43
Luxembourg	468.70	459.45	467.48	461.57	447.56	-4.02	3.92
Latvia	478.09	466.13	465.25	483.21	469.92	0.07	0.00
Russian Federation	472.42	472.82	476.09	499.65	478.39	3.88	1.24
Total	528.45	523.83	516.56	515.85	467.98	-12.89	7.01
Average	527.01	522.61	525.26	520.68	485.65	-8.47	4.51

1. “How often do you use a computer for electronic communication?” [IT5b]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.4: Frequency with which computers are used for learning school material1 by mean student performance on the combined reading literacy scale [IT5C]

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Mexico	449.50	458.69	449.60	436.71	403.48	-11.40	6.78
Russian Federation	489.84	488.55	488.89	470.55	451.78	-9.41	**11.70**
Denmark	499.36	507.81	513.85	497.28	462.06	-8.51	2.42
United Kingdom	520.16	538.20	551.60	530.79	486.07	-7.56	0.91
Australia	518.94	542.83	537.35	537.67	503.33	-3.64	0.41
Brazil	404.59	429.30	440.48	426.36	401.71	-0.87	0.02
Hungary	478.17	494.46	507.52	510.39	467.39	-0.56	0.01
Canada	522.83	537.68	548.42	541.13	520.92	-0.04	0.00
Liechtenstein	494.80	469.17	489.83	496.31	486.93	1.14	0.08
United States	494.30	519.26	540.51	541.27	489.58	1.26	0.02
Finland	526.04	544.49	560.17	562.83	529.19	2.46	0.17
Czech Republic	484.48	507.66	523.74	520.89	493.12	3.05	0.26
Sweden	496.78	518.07	531.19	526.66	508.34	3.17	0.45
New Zealand	503.03	537.25	556.51	546.18	527.60	5.81	0.76
Luxembourg	428.98	458.04	477.33	475.38	450.72	6.08	0.92
Norway	469.04	506.66	530.75	520.52	495.37	6.65	0.72
Latvia	435.35	471.79	483.85	473.09	469.66	6.99	1.70
Germany	467.02	494.66	520.24	518.44	490.24	7.02	1.02
Ireland	496.60	529.14	547.85	546.03	537.91	9.95	3.95
Switzerland	454.64	487.61	513.44	514.42	503.85	12.52	5.17
Belgium	469.47	506.42	538.71	541.68	527.39	15.11	5.37
Total	488.11	508.34	529.53	526.35	485.09	1.20	0.03
Average	487.94	511.65	529.29	526.89	499.50	3.84	0.40

1. How often do you use the computer to help you learn school material?" [IT5C]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.5: Frequency with which computers are used for programming1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Russian Federation	466.79	489.22	490.11	484.67	472.89	0.77	0.04
Mexico	426.36	446.34	458.29	457.31	434.96	2.82	0.34
Liechtenstein	479.63	462.00	468.28	482.17	503.31	6.75	2.49
Hungary	479.68	469.92	470.31	498.48	503.44	7.61	4.21
Canada	515.89	525.93	530.25	543.41	546.44	7.86	**92.98**
Brazil	406.26	405.42	418.01	435.83	432.65	8.32	**16.85**
Czech Republic	475.26	496.86	509.65	510.24	511.42	8.57	**10.32**
Latvia	432.58	441.86	465.42	467.24	484.41	12.90	**63.22**
United States	487.22	510.75	513.26	532.93	540.72	12.92	**57.18**
Luxembourg	431.70	431.83	460.26	474.68	475.62	13.07	**24.20**
Ireland	493.77	515.28	539.18	543.03	549.65	13.95	**28.26**
United Kingdom	491.10	516.91	529.50	547.70	546.90	14.24	**31.65**
Australia	492.04	516.46	527.40	541.09	552.09	14.47	**105.08**
Denmark	465.53	477.80	490.04	516.12	521.43	15.01	**88.27**
Sweden	481.34	490.38	510.13	523.15	540.76	15.16	**295.92**
Finland	505.05	524.41	532.13	552.88	566.67	15.17	**223.18**
Switzerland	459.72	472.92	492.00	507.75	518.24	15.19	**371.29**
Belgium	476.00	502.51	524.26	535.33	539.59	16.00	**35.02**
Germany	452.89	484.23	487.47	517.28	522.26	17.18	**42.03**
New Zealand	483.64	517.64	532.01	548.55	561.24	18.61	**67.99**
Norway	445.58	474.39	488.77	523.70	528.11	21.44	**73.07**
Total	478.06	495.34	505.16	523.93	524.91	12.23	**58.10**
Average	473.64	492.92	507.44	524.28	528.94	14.20	**94.58**

1. "How often do you use the computer for programming?" [IT5d]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.6: Frequency with which computers are used for games1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Brazil	419.67	427.91	433.65	430.84	390.14	5.61	1.00
Russian Federation	476.18	482.66	481.46	487.31	461.23	2.53	0.56
Hungary	485.21	489.29	502.60	509.51	464.00	2.22	0.12
Mexico	429.22	453.91	452.87	460.86	420.42	1.07	0.03
United States	496.22	528.85	537.24	543.85	496.10	-1.48	0.03
Denmark	494.61	502.68	508.85	522.11	497.70	-2.56	0.48
Latvia	454.71	469.09	482.97	488.30	462.20	-3.42	0.52
Canada	521.72	533.81	546.76	548.56	532.04	-3.54	1.01
Norway	494.13	511.25	533.42	531.99	508.85	-5.02	0.88
Germany	481.28	502.05	520.24	533.58	491.71	-5.24	0.54
Luxembourg	443.28	456.36	476.81	480.87	458.65	-5.53	1.39
Switzerland	485.55	494.60	515.53	518.86	501.92	-5.70	2.12
Finland	536.06	547.67	557.72	571.70	553.42	-5.88	3.03
Belgium	493.15	528.92	544.28	549.27	512.48	-5.90	0.58
Czech Republic	489.82	506.32	516.01	516.06	517.23	-6.46	**10.01**
United Kingdom	510.58	535.15	553.90	565.20	533.59	-7.61	1.47
Sweden	500.78	517.29	530.69	544.05	526.68	-7.86	4.40
Ireland	509.03	537.62	553.84	556.40	544.77	-9.03	3.86
Australia	504.20	526.06	543.15	549.27	539.62	-9.40	6.58
Liechtenstein	455.39	479.76	501.86	492.94	500.82	-10.40	7.87
New Zealand	506.83	530.83	550.85	562.96	547.70	-11.39	6.57
Total	492.15	513.95	525.32	533.54	484.30	-0.389	0.00
Average	495.79	512.86	527.45	535.71	505.41	-4.209	0.61

1. "How often do you use games?" [IT6a]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.7: Frequency with which computers are used for word processing1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
United States	513.80	530.88	539.45	490.75	420.80	22.61	3.89
Denmark	505.52	513.80	508.59	473.40	423.27	20.49	8.11
Australia	531.53	541.24	542.02	493.34	453.65	20.37	7.14
Liechtenstein	529.71	484.33	503.75	461.01	449.12	18.45	**12.64**
Mexico	478.16	465.79	450.50	444.98	396.95	18.32	**20.65**
Belgium	508.42	532.31	555.30	521.25	437.11	15.37	1.26
Canada	533.76	547.14	547.40	516.82	474.18	14.95	4.54
Sweden	513.27	523.92	534.87	510.03	450.79	13.88	2.47
Brazil	442.89	432.72	431.90	425.28	380.42	13.24	8.29
Hungary	495.88	497.10	504.96	495.20	430.83	13.20	2.67
Switzerland	489.56	518.93	520.55	501.76	437.47	12.14	1.41
New Zealand	521.05	545.98	564.96	525.16	471.51	11.99	1.24
Czech Republic	512.54	522.80	531.48	507.64	461.16	11.79	2.62
United Kingdom	525.27	537.93	551.91	517.56	477.36	11.62	2.22
Russian Federation	507.86	496.32	502.39	497.06	455.80	10.34	4.97
Germany	491.43	510.29	520.54	513.82	446.15	8.70	0.79
Finland	545.16	552.86	557.73	557.16	504.42	7.72	1.27
Norway	493.44	525.65	530.92	503.37	469.80	6.96	0.73
Ireland	525.97	546.73	554.44	539.62	496.75	6.56	0.79
Luxembourg	455.63	467.52	475.99	459.27	428.17	6.32	1.32
Latvia	460.63	482.42	490.41	475.60	439.03	5.00	0.54
Total	509.44	522.09	531.61	497.51	426.22	19.10	3.27
Average	508.26	523.70	532.73	510.35	450.19	12.95	2.02

1. "How often do you use word processing?" [IT6b]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.8: Frequency with which computers are used for spreadsheets[1] by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Mexico	445.35	461.38	461.05	456.15	418.68	5.857	1.10
Brazil	426.41	416.57	440.17	442.24	406.77	1.361	0.06
Russian Federation	476.32	494.04	499.72	502.24	469.88	0.468	0.01
Hungary	476.36	492.18	503.47	506.90	472.98	-0.796	0.02
Czech Republic	489.34	507.95	521.97	519.62	492.25	-1.749	0.10
Switzerland	466.63	504.12	517.41	526.07	480.10	-4.889	0.32
Latvia	428.67	481.93	490.23	487.08	451.25	-5.031	0.29
Liechtenstein	468.74	465.62	492.61	506.83	477.73	-5.919	1.25
Ireland	502.11	531.52	548.73	551.45	532.59	-8.089	2.21
Luxembourg	431.71	452.41	475.09	479.98	460.25	-8.465	2.80
Canada	504.71	521.57	543.66	550.39	533.53	-8.646	3.90
Belgium	483.21	517.69	545.18	552.66	510.59	-8.973	1.04
Australia	501.84	517.90	536.64	552.09	529.99	-9.049	3.92
Denmark	470.54	488.84	506.70	516.50	505.83	-9.824	8.23
Germany	460.40	491.97	507.89	527.04	499.46	-11.319	3.46
United States	479.32	506.53	524.56	547.88	519.07	-12.085	4.09
Sweden	480.53	493.70	518.52	530.07	525.76	-12.683	**19.38**
New Zealand	493.87	511.71	558.40	560.04	534.08	-12.875	2.93
Finland	492.00	531.44	545.28	561.47	553.94	-15.391	**11.08**
United Kingdom	482.70	512.12	542.24	554.05	538.99	-15.451	7.96
Norway	444.95	496.16	519.04	530.98	510.96	-16.684	4.90
Total	475.42	498.65	519.24	537.18	500.97	-8.963	1.77
Average	475.36	501.74	524.16	534.90	508.02	-9.848	2.61

1. "How often do you use spreadsheets?" [IT6c]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.9: Frequency with which computers are used for drawing, painting or graphics[1] by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Mexico	441.43	454.00	452.28	450.91	421.17	4.36	1.03
Russian Federation	480.84	495.78	497.39	495.92	461.64	3.83	0.55
Liechtenstein	512.37	468.43	483.78	499.25	485.65	2.26	0.15
Hungary	482.60	486.77	501.71	504.09	462.74	2.24	0.14
Czech Republic	483.71	508.53	519.03	519.04	476.99	0.29	0.00
Brazil	414.97	412.30	437.28	435.43	413.02	-1.92	0.19
Australia	512.02	523.46	537.58	546.59	527.31	-5.37	2.08
Finland	532.01	541.06	550.85	558.03	552.79	-5.85	**11.76**
Ireland	508.40	532.48	548.82	549.23	530.39	-6.07	1.47
Germany	468.85	496.23	517.17	527.05	484.07	-6.13	0.60
Canada	509.87	529.82	542.75	549.99	531.14	-6.27	2.19
United Kingdom	508.88	520.21	547.54	556.97	524.49	-6.80	1.22
Norway	477.85	508.65	525.56	528.90	501.72	-6.80	1.13
Luxembourg	435.57	451.82	475.72	479.55	455.88	-6.83	1.66
Latvia	433.39	466.16	483.32	488.05	458.31	-7.17	1.11
Sweden	494.49	507.79	524.08	531.98	520.23	-7.57	5.81
Denmark	482.03	487.87	505.63	518.71	505.72	-7.82	6.73
Switzerland	464.13	498.19	509.39	524.75	491.23	-8.08	1.41
United States	479.30	516.79	534.65	539.90	521.40	-10.73	3.10
Belgium	467.20	510.23	534.24	551.00	523.44	-15.33	4.21
New Zealand	485.96	520.68	546.50	559.84	545.35	-15.79	8.17
Total	477.13	504.41	523.19	532.06	499.13	-7.17	1.15
Average	482.57	505.62	523.59	532.79	507.03	-7.61	1.92

1. How often do you use drawing, painting, graphics? [IT6d]

$F_{.05}$=9.01; $F_{.01}$=28.24

TABLE 8.10: Frequency with which computers are used for educational software1 by mean student performance on the combined reading literacy scale

	Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never	Slope	F
Russian Federation	474.15	485.65	493.99	490.73	459.43	2.44	0.24
Mexico	430.48	451.03	460.44	457.20	421.91	1.10	0.03
Hungary	475.53	478.65	502.05	504.13	482.68	-3.98	0.83
Brazil	397.64	415.57	442.28	431.37	419.49	-5.95	1.36
Ireland	507.28	529.02	551.91	548.80	527.60	-6.04	1.15
Czech Republic	474.42	499.36	513.52	519.22	501.01	-7.30	2.41
United States	480.52	508.94	536.68	541.46	507.10	-8.57	1.28
Canada	491.66	526.51	545.03	549.57	529.95	-9.96	2.74
United Kingdom	491.14	520.59	548.82	551.75	529.14	-10.72	2.73
Latvia	427.79	465.85	469.67	488.24	475.39	-11.76	6.18
Liechtenstein	432.57	497.31	467.65	481.91	502.14	-12.37	2.88
Australia	480.27	520.04	539.69	547.73	528.80	-12.48	3.89
Luxembourg	413.78	439.62	471.00	481.62	466.74	-14.79	7.73
Belgium	461.99	504.73	542.61	554.04	514.78	-15.49	2.57
Germany	436.69	494.03	507.58	523.80	504.07	-16.45	4.64
New Zealand	474.45	517.47	553.97	559.74	536.66	-16.67	4.26
Denmark	450.34	468.16	495.25	519.07	510.24	-17.07	**21.41**
Switzerland	438.24	479.26	508.22	517.92	508.04	-17.83	9.05
Finland	481.29	519.87	544.52	562.24	552.01	-18.38	**12.49**
Sweden	456.50	484.11	512.64	531.87	526.21	-18.72	**22.00**
Norway	414.12	477.05	509.76	528.62	516.84	-25.70	**10.32**
Total	467.25	496.94	524.58	532.67	500.91	-10.31	2.00
Average	459.94	496.75	523.00	533.42	511.83	-14.05	4.54

1. "How often do you use educational software?" [IT6e]

$F_{.05}$=9.01; $F_{.01}$=28.24

USING ICT TO IMPROVE THE EDUCATIONAL OUTCOMES OF LOW ACHIEVEING STUDENTS – WHAT DOES THE RESEARCH TELL US?

WHAT CAN INTERNATIONAL ASSESSMENTS CONTRIBUTE TO HELP FIGHT LOW ACHIEVEMENT?

W.J. Pelgrum

University Twente, The Netherlands

INTRODUCTION

The overall theme of this conference is 'equity', an issue that is persistently high on the educational policy agenda of many countries and international organizations. More in particular this conference focuses on low achievement and ICT, in the expectation that ICT may play a facilitating role in helping low achieving student to do better at school.

In the literature one can find many claims and evidence that ICT indeed may help low achievers to improve. However, often it is not known to what extent ICT may have affected low achievement in education systems at large, how this is developing over time, and where successful practices can be found. The emphasis in this paper is on the question which evidence is or can be made available from international comparative assessments. It seems quite plausible to pose this question, because these assessments in particular focus on achievement, whereas also the problem of low achievement is experienced in almost any country.

The central question that will be addressed in this paper is whether international comparative assessment can or should contribute to fight the problem of low achievement. More in particular, the potential role of ICT as one of the factors that may contribute to improvement in this area will be highlighted. It should be noted that the analyses that are presented are highly explorative, because the time frame from preparing this paper did not allow for extensive analyses of existing databases.

What can or should international assessment contribute to help fight low achievement?

One of the first questions that need to be addressed is 'what actually is low achievement, how can it be defined?'. It may be of interest to consider this question from the perspective of the outcomes of international assessments.

Typically many international assessments report the achievement of students on international tests in terms of a number of statistics, amongst other which part of a certain population of students reaches particular levels on internationally calibrated achievement scales (see Beaton et all.,1997; Mullis et all., 2003). From statistics that were presented in these reports one may get a first impression of how achievement in certain subjects is distributed in each country. Typically one may note from these statistics that the score of low achievers in one country may be at the level of average achievers in other countries. Such findings raise a few questions regarding the definition of low achievement:

1. Should low achievement be defined locally or more broader?
2. Can low achievement be defined from a mono-disciplinary perspective?
3. What actually is the criterion to define low achievement?

These questions and some reflection will be shortly presented below.

Question 1 relates to a well-known dilemma for many educational practitioners. Defining low achievement locally may be unfair, because (when applied for instance to schools and classrooms) a given student might be called low achiever in a high ability classroom while he or she might be a high achiever in a low ability classroom. The same holds within countries: low achievers in one country might be considered average achievers in other countries.

Question 2: acknowledging that people are different in terms of predispositions, interests, etc., One may wonder if low achievement can be based on achievement in one or a few school subjects alone. Although not being an expert in this area, the author of this paper would claim that low achievement should be rather defined in a multidisciplinary way. This would acknowledge that students can excel in certain areas but will lag behind in other areas.

Question 3 actually relates amongst others to the distinction between criterion- and norm-based testing. One should keep in mind that international comparative tests are norm-referenced. One implication of this is that the tests are constructed in a way to maximally discriminate between students and that (in order to reach a high reliability of the scales) the p-values of items would ideally be around .50. In contrast, criterion referenced tests do not impose these restrictions, but could be less suited for analyses purposes (in case for instance the whole population would reach the maximum score). The most important implication is that low achievement will exist per definition if norm-based criteria for defining low achievement are applied.

The above is meant to illustrate that low achievement may be difficult to define when considered from an international comparative assessment perspective. Nevertheless, one may more or less arbitrarily set a criterion, for instance the bottom 10% or 25% of the achievement distribution and next consider the question what can be learned from international assessments. Obviously, once such a definition is adopted, there are several possibilities to investigate low achievement from an international comparative perspective. For instance, the characteristics of this group may be explored in terms of background characteristics of students (socio economic status of the home, home academic climate or other indicators that are measured in these assessments), attitudes, characteristics of the teacher, the school, etc.. In terms of the theme of this conference one may wish to investigate ICT related issues (such as access at schools and at home). However, probably most relevant would be to

explore how the achievement distribution is changing over years: a potential indicator of the beneficial effects of (certain types of) ICT-use might be that an increase of (particular types of) ICT-use would be associated with a decreasing gap between high achievers and low achievers. Also changes in motivation (interest in learning, attitudes to schools) might be taken as positive results. In theory these analyses are starting to become possible on the basis of existing and forthcoming international data files. To the knowledge of the author such analyses have not yet been performed.

A first clue to potential improvements for low achievers may be gained from trend statistics that will increasingly become available in the forthcoming years. For instance the recently published trend results from PIRLS (Mullis et all. , 2003) may lead to the hypothesis that in certain countries improvements could be observed at the lower end of the distribution of reading achievement. From the statistics that are presented by Mullis et all. (2003), one may tentatively infer that low achievement in reading seems to have diminished a bit in Greece, Slovenia, Iceland and Italy, while in other countries the trend may be different. Although it would not be warranted to use two measurement points for making inferences about trends, one may argue that new measurement points from future assessments (providing that the measures themselves are not changed) will offer possibilities for studying developmental trends regarding low achievement over time. Such trends then need to be interpreted on the basis of context information about the curriculum, teaching methods, etc.

Which evidence is available from international comparative assessments?

In this section a review will be presented of several issues that relate to low achievement and ICT. Given the background of the author this review will be based mainly on databases that have been created by the IEA. These databases are shortly described in Annex 1 and quoted from the IEA web sites: www.iea.nl.

Although these studies were not particularly designed to investigate the problem of low achievement, they may offer some clues regarding the perceptions of educational practitioners that relate to this problem. For instance, in SITESM1 school principals were asked to give their opinion about the statement *"The achievement of students can be increased when using computers for teaching"*. This question does not address the issue of low achievement but a general positive response could be taken as an indicator that school principals might be inclined to invest in ICT in order to raise achievement. The answers of the school principals per country are shown in Table 1.

From Table 1 it is interesting to note that, in 1998, the expectations of school principals about the potential of ICT to help increase achievement were very positive. Also remarkable is that in some countries the responses were much more at the extreme positive end than in other countries. Such finding in itself is without additional data difficult to interpret. But in combination with other data it may offer us a piece of the picture.

Table 1

Percentage of school principals (lower secondary education) responses to the question 'The achievement of students can be increased when using computers for teaching'.

Country	Strongly disagree	Slightly disagree	Uncertain	Slightly agree	Strongly agree
Belgium-French	2	2	15	65	16
Bulgaria		2	5	38	55
Canada	2	4	21	45	29
China-Taiwan	2	1	6	57	35
Cyprus			16	34	50
Czech Republic	0	6	20	59	15
Denmark	1	5	38	48	9
Finland	4	7	43	37	8
France	1	1	27	56	15
Hong Kong	2	9	54	32	4
Hungary	2	8	29	47	14
Iceland		1	15	56	28
Israel		1	4	26	69
Italy	1	4	12	19	64
Japan	3	16	59	20	2
Lithuania		3	2	36	59
Luxembourg		19	38	25	19
New Zealand	5	6	25	33	31
Norway	0	2	19	58	22
Russian Federation		3	4	49	44
Singapore			8	46	46
South Africa	1	1	20	42	36
Thailand	1	1	8	40	51
Slovenia		5	33	57	6

Exactly the same question was also asked in CompEd-1992, that is roughly 6 years before. Unfortunately, at the level of lower secondary education, there was only one country overlapping between these two data sets, but it seems still interesting to mention that during this period of time a remarkable change occurred (see Table 2).

Table 2

Percentage of school principals in Japan (1992 and 1998) who responded to the statement that "The achievement of students can be increased when using computers for teaching'

Country	Strongly disagree	Slightly disagree	Uncertain	Slightly agree	Strongly agree
Japan-1998	3	16	59	20	2
Japan-1992	1	4	45	44	7

The opinions of school principals at the lower secondary level in Japan about the question whether computers can help to improve student achievement tended to become less optimistic. Whereas in 1992 a slight majority agreed with this statement, this had turned into a minority 6 years later. At this stage we can only speculate about this finding. Could it mean that as a result of increased experience

with applying ICT in schools, the principals have become more pessimistic? Although at this moment convincing answers cannot be generated, these statistics illustrate that monitoring developments over time may provide insight into certain factors that are important to understand these processes.

On the basis of this question one may of course not infer that ICT is beneficial for low achievers, but rather the extent to which in general the school principals seem to expect positive benefits for achievement in general. One may hypothesize that such expectations will influence decisions about using ICT for improving achievement.

As school leaders are importing gatekeepers but also potential initiators of new developments in the school this may be taken as a reassuring finding, certainly if it is also combined with another attitude-item that was used in SITESM1: "ICT can help teachers to attune to the learning level and pace of individual students'. The answers on this item are shown in Table 3. It appears that in most countries a substantial number of school principals have positive expectations about the potential of ICT to arrange learning in a way that is more tailored to individual students' needs. Such finding could be further investigated by examining to what extent this relates to school policies and ICT-supported instructional approaches.

Table 3

Percentage of school principals (lower secondary education) responses to the question 'ICT can help teachers to attune to the learning level and pace of the individual student'.

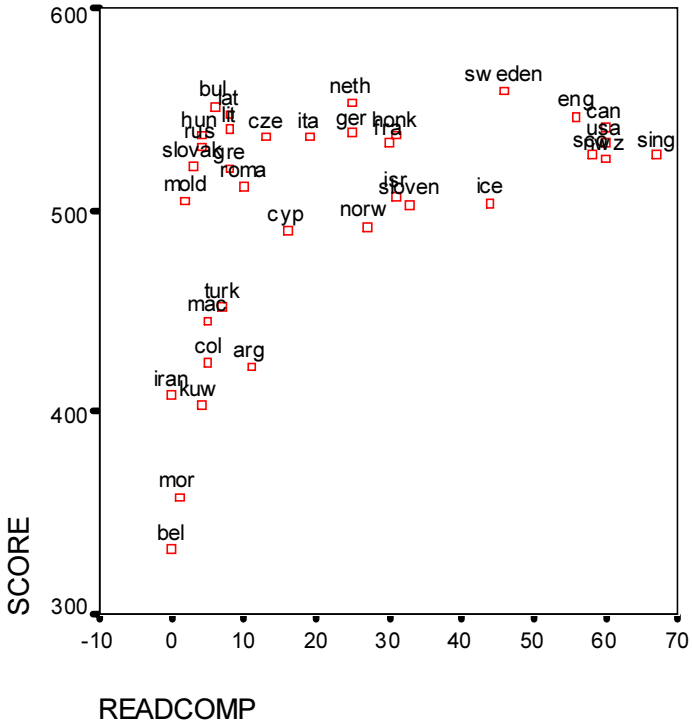
Country	Strongly disagree	Slightly disagree	Uncertain	Slightly agree	Strongly agree
Belgium-French	1	6	8	58	28
Bulgaria	1	1	7	47	45
Canada	1	3	16	46	34
China-Taiwan	2	1	9	50	39
Cyprus			15	61	24
Czech Republic	1	5	12	53	30
Denmark	1	6	32	50	11
Finland		3	23	61	13
France	0	2	19	60	19
Hong Kong	1	3	17	60	20
Hungary	0	6	33	51	9
Iceland		1	20	52	28
Israel			8	36	56
Italy	3	4	20	27	46
Japan		7	18	52	23
Lithuania	2	4	9	37	49
Luxembourg		6	44	31	19
New Zealand	2	3	21	40	34
Norway	1	3	24	55	17
Russian Federation	1	7	10	44	37
Singapore			6	29	65
South Africa	2	1	15	41	41
Thailand	1	1	8	43	46
Slovenia		4	14	63	20

More relevant than these opinion questions would be to explore the more direct links between achievement and the use of ICT. When examining the results of PIRLS it appears that, at the aggregated level of countries, the correlation between the percentage of students that read at least once a month at the computer and the reading scores is roughly .40. However, it is likely, as illustrated in Figure 1, that this relationship is merely indicating a co-variation between economical welfare and educational outcomes.

-

Figure 1

Covariation between percentage of students using a computer for reading at least once a month (READCOMP) and their reading score (SCORE). Source: Mullis et all., 2003.



Another IEA study that the author has examined in some detail in order to explore the relationship between achievement and the use of ICT, is the mathematics part of TIMSS-1995. A quite peculiar finding from TIMSS-1995 was that it appeared that students who used computers frequently for mathematics learning had lower scores than the students who hardly or never used computers for this purpose. Pelgrum and Plomp (2002) showed that these achievement differences could amount to an equivalent of 2.3 years of schooling (see Table 4).

Table 4

Differences in achievement between groups with high and low ICT use, and upper and lower grade, and number of years high ICT use group was lagging behind (second column divided by the third)

Country	*Achievement score differences*		*Years behind*
	High ICT–Low ICT	*Upper grade–Lower*	
Canada	−50	33	1.5
Cyprus	−48	28	1.7
Denmark	−23	39	0.6
Greece	−43	44	1.0
Iran, Islamic Rep.	−33	29	1.1
Japan	−8	34	0.2
New Zealand	−66	37	1.8
Philippines	−31	13	2.3
Romania	−15	27	0.6
Sweden	−65	36	1.8
Thailand	−13	25	0.5
England	−56	31	1.8
Scotland	−45	35	1.3
United States	−47	22	2.2

Source: Pelgrum&Plomp, 2002

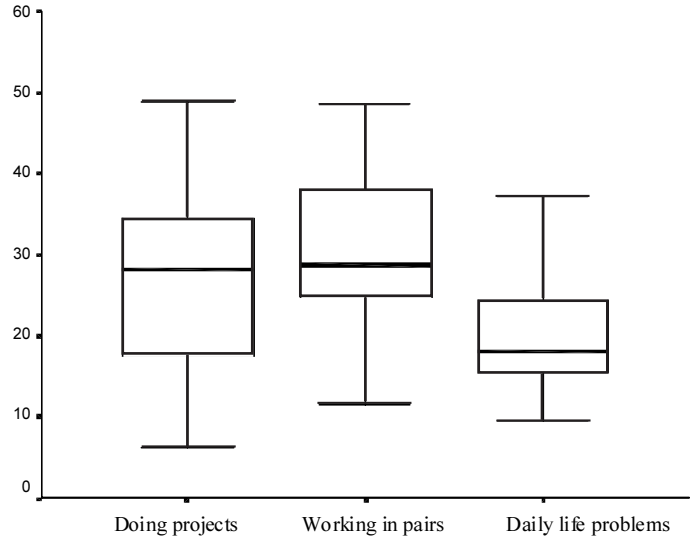
This puzzling finding was further analyzed in order to find potential explanations. A first hypothesis was that computers are mainly used for drill and practice for remediation purposes of low ability students. In that case, it was argued, one might expect differences between these groups in terms of home background variables. However, this did not appear to be the case. The authors demonstrated that a major difference between the two groups of students was the extent to which teachers were using student-centred didactical approaches. Their statistical analyses showed that two patterns could be discovered in the following list of activities, which students had to judge with regard to frequency of occurrence during mathematics lessons:

1. Teacher shows how to do problems,
2. Copy notes from the board,
3. Have a quiz or test,
4. Work from worksheets on our own,
5. Work on projects,
6. Use calculators,
7. Use computers,
8. Work in pairs or small groups,
9. Solve with objects from everyday life,
10. Teacher gives homework,
11. Begin homework in class,
12. Teacher checks homework,
13. Check each other's homework,
14. Discuss completed homework.

A first pattern consisted of activities that referred to the use of student-centered approaches (with typical items, such as 5, 8, and 9 in the list above), while a second pattern consisted of teacher-centered approaches (typical items were 1, 2, and 10). When examining the differences between the "high" and "low" ICT using groups, the student-centered items appeared to differentiate particularly strongly. This is illustrated in Figure 2. In all countries a higher percentage of students in the frequent use group also frequently were involved in project work, working in small groups or working on mathematical problems related to daily life.

Figure 2

Summary of country differences in percentages (doing projects, working in pairs and use daily life problems in mathematics) between high- and low-computer-use groups. Source: Pelgrum & Plomp (2002)



Note. Only for countries where each group contained at least 150 (unweighted) cases

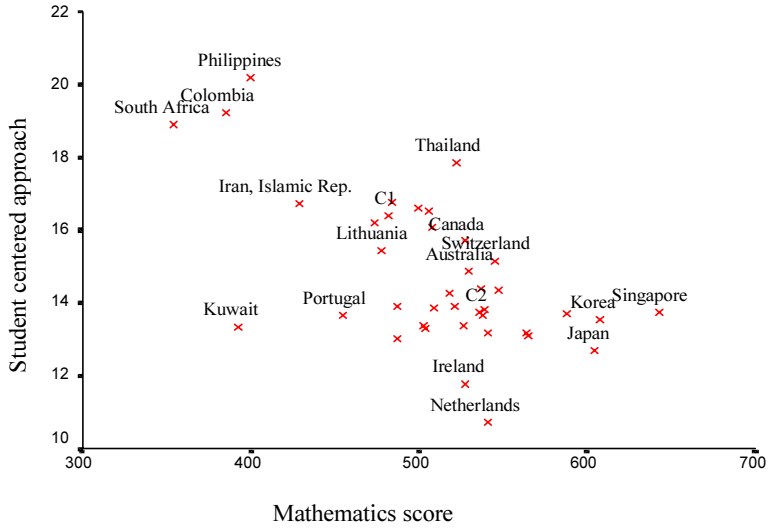
In order to examine this observation in somewhat more depth, Pelgrum & Plomp (2002)constructed a composite indicator that was based on the following items:

- During mathematics lessons, we work on projects.
- During mathematics lessons, we work in pairs or small groups.
- During mathematics lessons, we solve mathematics problems with every day life things.
- During mathematics lessons, we check each other's homework.
- When new topics are introduced, we first discuss practical problems.
- When new topics are introduced, we first work in small groups.
- When new topics are introduced, the teacher first asks what students already know.

It appeared that the mean scores on the indicator for student-centered didactics and the mean mathematics scores for each country (as shown in Figure 3) seemed to be negatively associated.

Figure 3

Plot of mean values per country for TIMSS–95 mathematics scores and an indicator of students centered didactics (Source: Pelgrum&Plomp, 2002)



Legend.

C1: Cyprus, England, Greece, Hong Kong, New Zealand, Romania, Spain, United States;

C2: Austria, Belgium-Fl, Belgium-Fr, Czech Republic, Denmark, France, Germany, Hungary, Iceland, Israel, Norway, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden.

In the end the authors commented that *"... it may be hypothesized that the large score difference between the high-computer-use and low-computer-use groups is caused by a pedagogical approach in which less emphasis is placed on competencies such as those measured in the TIMSS–95 mathematics tests. "*

The evidence from quantitative studies that was presented above does not yet throw much light on the question whether ICT can help to fight low achievement. The examples were used to illustrate that international comparative research may offer possibilities to get more insight in this question. In particular the trend data, when analyzed with a focus on low achievers and the types of use of ICT offer possibilities in this direction.

Next to quantitative studies on ICT in education there were, as mentioned above, in recent years a number of international research studies conducted that used a qualitative methodology (Kozma, 2003; Venezky & Davis, 2002). Below we will illustrate how educational practitioners who participated in the IEA SITES Innovative Practice Module (Module 2, further abbreviated as SITESM2) perceived the impact of ICT, in particular in so far as it concerned the effects on low achievers.

Quite noteworthy in SITESM2 is that roughly 10% of the cases contained evidence of a particular impact on low ability students or students at risk. The following quotes are meant to illustrate this point (bolded are specific references –sometimes rather implicit- to low achievement, using the words of the educational practitioners who where interviewed). The quotes are taken from cases that were studies in different countries. However, as these cases do not represent the countries in a statistical sense, the country names have been left out.

In the eyes of the supervisor, ICT is of great value for ***weak students,*** *revealing hidden strength points and strengthening the bond with the parents. The parents feel that their children are advancing in their studies and are highly appreciated. "You discover a lot of kids who don't do so well in class, or who don't express themselves so well, or are sort of absent-minded… you see them by the computer, displaying products that are so beautiful… It also created a tighter bond especially with the parents of the problematic children, because you could find points in favor of these kids."*

In actual fact, within the computer trustee group there are some students with ***lower abilities*** *who benefit from the innovation. Some are students with learning disabilities, which due to the encounter with the computer and the innovation as a whole have gained appreciation, respect and higher self-esteem: "There is a student who was at the edge of committing suicide, and due to the innovation, he practically came back to life." (The computer coordinator)*

Teachers compliment the excellent students' communication and relationship within the center. Two mothers refer to this point: "They are required to organize things differently… he has an opportunity to explain to others. This is very important. This is what gives them their self-esteem, because you don't only learn, you also teach and explain to others." "They can help one another ***without feeling weaker, not like before****… So I help you with something and you help me with something else."*

ICT supports the innovation in a number of ways. First, enriching the variety of teaching methods and accommodating them to the students' needs. As the Art teacher asserted:"Some of the students do not feel comfortable working with certain materials, and they experienced a ***disconnection regarding art classes.*** *Now they can join the lessons… that way there are much less discipline problems, and the students are much more satisfied."*

With ICT, pupils feel that the progress is very much taken into account for their assessment and the final product is always better so they are more relaxed, their self-esteem increases and their outcomes improve.

One of the teachers said: "ICT is perfect for pupils with ***special needs,*** *they can listen to their own voice, produce accurate and clean works, etc. Their self-esteem greatly increases"*

There was wide agreement amongst school staff, parents and pupils that individual access to a PC had benefited pupils in a number of ways:

- *motivation: pupils were more enthusiastic about school work;*
- *presentation of work: all pupils, irrespective of ability, were able to produce well presented, attractive work;*
- *the inclusion of pupils with* ***special educational needs*** *(including behavioural disorders): the headteacher commented, '… for the first time in their careers they have felt success. They can all go as far as they can go. [There is] No exclusion in opportunity';*
- *ability to work independently: each pupil decides whether to use ICT or traditional methods for a particular task;*
- *ability to organize their work (i.e. prioritize): pupils have to maintain progress with existing assignments as well as responding to new tasks; they use Outlook to list tasks set/completed;*
- *learning gains: the head teacher stated, 'The evidence of children applying themselves is in the work', and referred to high achievement in National Curriculum Assessments for pupils;*
- *confidence and self-esteem: pupils of all abilities worked confidently and purposefully, and were proud of the work they produced.*

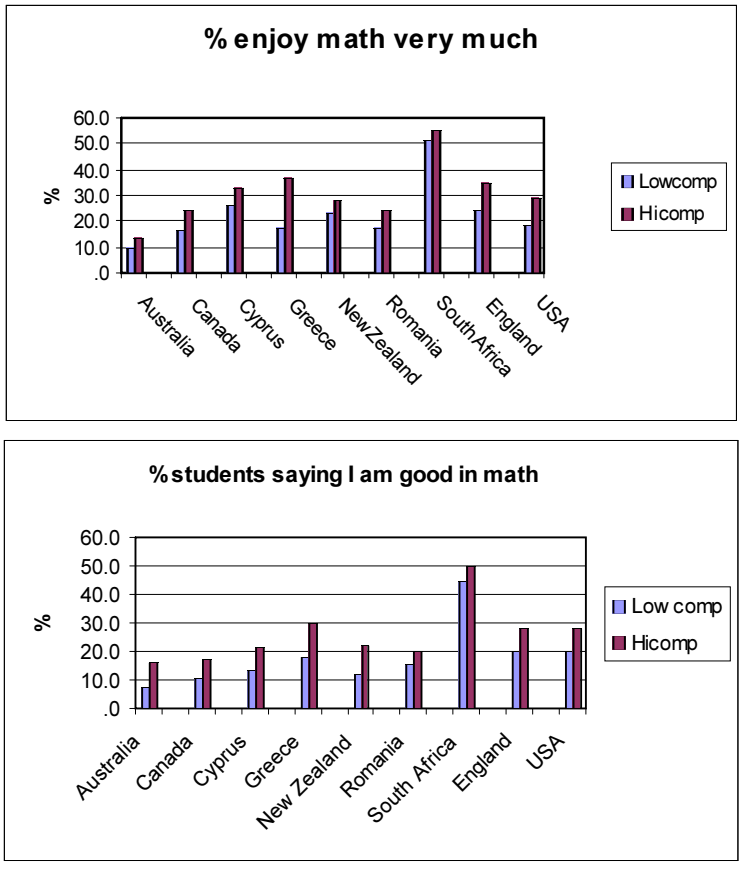
The observations as quoted above are potentially quite interesting and promising when it regards low achievers. Noteworthy is that increase of achievement was not the most eye-catching impact, but rather motivation, self-esteem and self-confidence stroke quite a number of practitioners. One may argue that the decrease of disciplinary problems is related to this phenomenon. The fact that these are perceptions of educational practitioners requires some caution in the interpretation.

Although SITESM2 was not explicitly designed to investigate the problem of low achievement in relation to the potential benefits of ICT, the above observations (which more or less emerged from the data) may serve to illustrate that a further in-depth analysis of these data may help to throw more light on this issue.

One may wonder to what extent the phenomena that are reflected in these perceptions can also be observed in quantitative international data. In order to explore this question, we took the TIMSS-1995 data bases and analysed to what extent low achievers (defined as the bottom 25% of the score distribution), who used ICT relatively frequently for learning math reported higher enjoyment in studying math and being good in math than the low achieving students who hardly or ever used ICT. A particular problem that occurs when doing these analyses is that the number of cases in the breakdown groups is becoming very small for a considerable number of countries. Therefore only countries were retained that had at least 50 students in a group and no tests of statistical significance were conducted, but rather the general trends are inspected. The results are shown in Figure 4.

Figure 4

Percentages of students (participating in TIMSS-1995 who used computers frequently –Hicomp- and hardly or never –Lowcomp-) at the lower secondary level who very much agreed with the listed statements. Selection of countries that had at least 50 students in each group. Source: Pelgrum&Plomp (2002)



It is interesting to note in Figure 4 that as a general trend the low achieving students in the Hicomp group more frequently reported that they enjoyed mathematics and that they were good in it. This observation corresponds with the observations that were made in SITESM2.

Summary and reflections

In this article a review was presented of possibilities that international comparative assessments may offer for gaining insight in the problem of low achievement and in particular how this problem develops over time and to what extent ICT may help to gain more insight into this problem and possible solutions that have shown their value for education at large in some countries throughout the world. It was argued that the international assessments of the OECD (PISA) and IEA (TIMSS, PIRLS) with their focus on achievement in core subjects in combination with their cyclic character can offer insight in the extent to which low achievement exists in different countries and to what extent changes are taking place over time in particular populations of students. Arguments were put forward that defining low achievement in international assessments is problematic because, when taking a relative criterion low achievement will exist per definition and may seem to never disappear.

It was shown (on the basis of SITES Module-1) that school leaders seem to be positive about the impact ICT may have on achievement and the possibilities to help to take into account difference in learning pace.

Also the cases study materials from the IEA Second Information Technology in Education Study (SITES) were explored. It was interesting to observe that educational practitioners perceived positive effects for low achievers, when applying ICT in innovative practices. In particular reference was made to affective effects such as improved motivation, self-confidence and self-esteem. Mentioning of positive achievement effects occurred only sporadic. An exploration of the TIMSS-1995 data confirmed these perceptions: as a general trend it was observed that low achievers (defined as the bottom 25% in the score distribution) who used ICT relatively frequently for learning math reported more frequently than their peers who hardly or never used computers for math, that they enjoyed learning math and that they thought they were good in it. Reflecting on the above we may tentatively conclude that from international assessments something can be learned about the problem of low achievement and whether ICT can contribute to solve this problem. This being said we should immediately add that from the available evidence it seems unlikely that ICT will be primarily beneficial for improving achievement per-se. Rather it seems more likely that the use of ICT flourishes when teachers change their pedagogical approach from primarily teacher-directed to more student-directed. In such pedagogical climate, where the emphasis shifts from being highly cognitive and reproductive to more cooperative, creative and productive low achievers (usually perceived as cognitively lagging behind) get a chance to experience and show their strengths in other areas. When doing math projects these other areas may be activities such as organizing, data collection, presentation, etc. It seems plausible that this may lead to higher self-esteem and self-confidence. Although one may expect that this re-appraisal of a student's own value can result in more motivation to get actively involved in learning math, such effect is an indirect consequence rather than a primary result.

Although the analyses that were presented in this article were rather superficial (for instance the type and intensity of ICT-use could not be considered in detail, the SITESM2 cases were not examined systematically) it seems that it is warranted to plea for devoting more attention in international assessments to the specific problem of low achievement. As a first step towards such emphasis the following set of recommendations are offered for consideration:

- Establish working groups of international experts in the area of low achievement who can provide suggestions for indicators and instruments that should be included and who can assist in the analyses and reporting of the international data.
- Establish international criteria for defining low achievement.
- Conduct trend analyses wit specific emphasis on factors (school policies, specific uses of ICT, motivation) that are associated with low achievement.
- Include case studies of best practices that may be selected form the quantitative data

Finally it seems that one should be realistic with regard to expectations on whether the problem of low achievement can be solved completely, as is illustrated with the following quote from one of the cases that were studied SITESM2:

"Despite the dramatic increase in students' access to ICT, the gap between high and low achievers still persists. All students indeed have access to ICT resources, but teachers claim that each student advances in relation to his or her starting point. As a rule, the higher ability students display higher competencies using ICT. On of the parents expressed it as follows: "ICT is a means of reducing the gap between edges. It's impossible to close it completely."

REFERENCES

BEATON, A. E., MULLIS, I. V. S., MARTIN, M. O., GONZALES, E. J., KELLY, D. L. AND SMITH, T. A . (1996)
Mathematics Achievement in the Middle School Years. Chestnut Hill, MA: Boston College.

MULLIS, I. V. S., MARTIN, M. O., GONZALEZ, E. J., KENNEDY, A. M. (2003)
PIRLS 2001 International Report. IEA's Study of Reading Literacy Achievement in Primary Schools in 35 Countries. Chestnut Hill, MA: Boston College

PELGRUM, W. J., ANDERSON R. E. (EDS), (1999)
ICT and the Emerging Paradigm for Life-Long Learning. Amsterdam: IEA.

PELGRUM, W. J., PLOMP, T. J. (2002)
Indicators of ICT in mathematics: status and covariation with achievement measures. In: Beaton A E & Robitaille D F R: *Analyses of TIMSS-data*. Dordrecht: Kluwer.

ANNEX 1: DESCRIPTION OF IEA-SITES DATA SOURCES

The IEA began its first information Technology/Computer in Education Study (COMPED) in 1986. Data was collected in 1989 and again in 1992 from school principals, computer coordinators and teachers. Students were also surveyed and tested in 1992 (the second stage). The study described and analyzed the situation with regard to the introduction and use of computers in education systems around the world.

Compared to the 1980s, when many countries were introducing an early generation of microcomputers into their schools, the current policy debates regarding technology deal with a much broader range of issues, for example, widespread adoption of the Internet and multimedia technologies. These new technologies raise new questions about the effectiveness and impact of technological applications on schooling. Are our education systems measuring up with regard to innovative potential of these applications? To what extent are there gaps between objectives and educational reality? Which innovations exist and what is the evidence of their effectiveness?

The intention behind SITES was to help answer such questions. The study was focussing primarily on the use of information and communication technology (ICT) in educational practice from an international comparative perspective, and will be guided by several general questions, including:

- How, by whom, and to what extent is ICT used in education systems, and how does it develop over time?
- What differences in ICT-related practices exist within and between educational systems and how can these differences be explained?
- Which innovative practices exist that may offer educational practitioners achievable new targets?

SITES consists of three independent modules: the Indicators Module (quick school survey); the Innovative Practices Module (case studies, Module 2); and the Survey Module (school, teacher and optional student survey).

The Indicators Module (Module 1) included a short school survey and was conducted in 1998/1999. The population was comprised of all primary and secondary schools, and the respondents were school principals and their technology coordinators. The questions included summaries of ICT resources, access and utilization of these resources, and indicators of their integration into the instructional processes. In Module 1 of SITES 26 countries participated, including:

Belgium (French), Bulgaria, Canada, Chinese Taipei, Cyprus, Czech Republic, Denmark, Finland, France, Hong Kong SAR, Hungary, Iceland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Norway, New Zealand, Russian Federation, Singapore, Slovenia, Slovak Republic, South Africa, Thailand.

The first report of Module 1 was released in 1999 (Pelgrum & Anderson, 1999). The report contained data from other sources including TIMSS. It is available in printed form as well as on the World Wide Web (www.iea.nl).

SITES Module 2 (M2) was an international qualitative study of innovative pedagogical practices that use information and communication technology (ICT). In each participating country, national panels used common selection criteria, modified by national context, to identify innovative classrooms. National research teams used a common set of case study methods to collect data on the pedagogical practices of teachers and learners, the role that ICT plays in these practices, and the contextual factors that support and influence them. Altogether 174 case studies were conducted in 26 countries. The International Coordinating Center (ICC) conducted a cross-national analysis of the cases. Implications were drawn for both improved policy and classroom practices. The international report was published in June 2003.

E-LEARNING AS A MEANS OF PROMOTING EDUCATIONAL EQUITY IN RURAL AND REMOTE COMMUNITIES:

A Canadian Case Study

Gerald Galway

Department of Education Government of Newfoundland and Labrador, Canada

Change and Challenge: Education in the Province of Newfoundland and Labrador

Newfoundland and Labrador is Canada's newest and most easterly province, joining the confederation in 1949. It is small demographically, with two-thirds of its population (520,000) residing in small, rural and remote communities, however its geography covers an expanse of more than 400,000 square kilometres. It has a land mass four times the size of Hungary with a population almost 20 times smaller. Rural schools, which typically offer thirteen grades and often have fewer than 100 students, account for two thirds of all schools in the province. Many remote K-12 schools have fewer than five students in the kindergarten cohort and most will have some multi-graded classes, particularly at the K-9 level. These schools also offer part of their high school curriculum via the Internet through a virtual school operated by the Centre for Distance Learning and Innovation[1].

A major challenge facing Newfoundland and Labrador is a significant population decline. Associated demographic factors, notably changing fertility rates, out-migration and an aging population, have had a more profound impact on the school-aged and post-secondary population than on other population groups. The province has experienced more than 30 years of declining birth rates, net out-migration and enrolment declines. The province's birth rate, once the highest in the country, is now the lowest – indeed it is one of the lowest in the world. Since 1971, Newfoundland and Labrador's median age has increased by more than 15 years and now stands at 36.5. Statistics Canada anticipates that the Newfoundland and Labrador population will continue to age more rapidly than that of Canada.

This combination of an extremely low birth rate and a large number of *baby boomers* (currently around 35 to 55 years of age) quickly moving past their prime childbearing years means that birth rates in Newfoundland and Labrador will continue to decline. The implication for the education system is demonstrated by startling changes in K-12 enrolment, which has declined from a peak of

1. See www.cdli.ca

163,000 students in 1971 to approximately 84,000 in 2003, representing a drop of almost fifty percent. In fact, the size of the 2003 Kindergarten cohort was just 5200, down from almost 13,000 three decades ago. In the next ten years, the provincial enrolment is expected to decline even further to fewer than 60,000 students, with fewer than 4,500 students entering school annually.

To adjust to this demographic change, the province, during the 1990s undertook a substantial educational restructuring effort[2]. To stay viable in the face of enrolment loss, many rural schools in Newfoundland and Labrador were consolidated with adjacent schools in their region. School boards were consolidated and over a ten year period from 1993 to 2003 the number of schools was reduced by almost two hundred. Yet, there are still significant challenges associated with delivering a responsive education program to a small population that is dispersed across a large number of small remote communities. In an environment of rural depopulation, accessibility, quality, affordability and equity are all problems from the perspective of educational programming.

The results from the 2001 School Achievement Indicators Program (SAIP) Canadian context study showed that some of the lowest socio-economic levels in the country exist in rural Newfoundland and Labrador[3]. Rural schools in the province have significantly lower student achievement levels than either urban schools within the province or rural schools elsewhere in Canada. A recent Statistics Canada urban-rural analysis of the Program for International Student Assessment (PISA) 2000 reading results showed that urban students in Newfoundland and Labrador performed on par with urban students in the top ranking Canadian provinces[4]. Rural students in Newfoundland and Labrador, however, ranked behind most other provinces.

While educational achievement and the preparedness of rural graduates must be considered against this contextual backdrop, residents of rural communities still expect an education system that can demonstrate continuous improvement, and graduates students with a high quality education that prepares them for an ever-changing world. In a global labour market, graduates from small communities must compete with graduates from larger centres on an equal basis.

The E-Learning Model

In Newfoundland and Labrador, restructuring efforts did not fully address the problem of delivering a responsive education program to a dwindling student population dispersed across a vast geographic area. To further respond to these challenges the province and its school boards developed and implemented a series of policies and strategies aimed at providing students, regardless of their place of residence, with access to an education is focused on high student achievement and readiness for post-secondary study. ICTs[5], in particular the use of e-learning to supplement traditional classroom delivery of high school programs, were a major component of the approach developed to achieve this aim.

2. The number of schools in the Province of Newfoundland and Labradors has declined from approximately 1250 in 1961 to 317 in 2003.
3. Council of Ministers of Education, Canada. (2003). Mathematics Learning: The Canadian Context, 2001 School Achievement Indicators Program. Author.
4. See: www.statcan.ca/english/IPS/Data/81-595-MIE2002001.htm
5. For the purposes of this paper, ICT can be broadly defined as encompassing: on-line learning via the internet; other forms of connected learning such as local area networks; learning through stand-alone applications and media such as CD-ROMs; and learning through other forms of electronic or interactive media

The concept of distance learning is not new in Newfoundland and Labrador. Beginning in 1986, distance learning was offered through teleconference and print materials. This approach involved the independent use of specially developed student resources and real time teacher communications through a telephone-based audio graphic system. However the delivery mechanism was not particularly flexible, owing to scheduling problems and other administrative constraints; costs were high; it was not appropriately scalable to allow for the participation of larger numbers of students or the offering of a full range of courses; and the technology was outdated and inefficient. Since all resources were print based, updates were slow and expensive. The telecommunications system was also saturated, and adding additional students was expensive.

To overcome the problems associated with traditional distance education approaches, in 2000 the province created the Centre for Distance Learning and Innovation (CDLI). The CDLI built and implemented a new model of distance education based on the blueprint defined in a Ministerial Panel report[6]. The new model is IP based, meaning it relies on the use of computers, networks and the Internet. It is immediate, easy to update, and provides a range of content and ways of interacting. Access is not locked to a prescribed schedule of communications times. All content and communications are digital, allowing for a more seamless blending of traditional and newer forms of content and learning experiences. The CDLI's approach combines synchronous (real time interaction) and asynchronous (delayed time interaction) instruction. Student learning occurs through both web-based lessons and real-time Java-enabled enhanced audio graphic instruction. The model also includes a database driven course tools package that provides online learning activities and allows students to be evaluated and track their own results and progress online.

The main stakeholders in the design of the e-learning system were independent expert educators, former and current teachers, technical experts, content developers and policy makers at the school district and ministry levels. Implementation involved some of the same stakeholders but added virtual teachers (e-teachers), local teachers and administrators and university researchers. Evaluation is ongoing as part of an established research process conducted by university faculty researchers.

Program Delivery and Resources

The CDLI uses the application of web-based software and a high speed intranet to create a series of virtual classrooms that are not subject to the limitations imposed by geography. This model permits Aboriginal and other students in the province's most northerly and remote communities to learn mathematics and other high school subjects in the same class with students in various communities on the island (Newfoundland) or in other parts of Labrador. The Centre is a highly decentralized organization with e-teachers and infrastructure spread throughout the province. Students and e-teachers communicate with one another in real time and use a computer screen in the same way that a traditional teacher would use a chalkboard, with technology known as graphics tablets. The teacher combines e-mail, audio- and video-conferencing, Internet, fax, recorded classes and conference forums to deliver the program. At the school site, mediating teams assist students with on-site logistics and routine questions.

The CDLI now offers 27 high school courses in 95 sites throughout the province. The province plans to double the number of course offerings within two years, and add courses in such subject areas as music, art and family studies. The Centre also employs an e-guidance counsellor. The expe-

6. http://www.edu.gov.nf.ca/panel/cover.html

rience of senior students is also used in the e-learning model. Through a complementary program called *Tutoring for Tuition*, each site has a designated student tutor to assist on-line learners. Tutors help their peers with operating the computer hardware and software necessary for web-based learning and in return receive a tuition voucher for post-secondary study.

The CDLI has a mandate to develop and deliver online professional development programs and services for primary, elementary and secondary teachers; and online programs and services for other adult learners using the Internet. To this end the Centre has partnered with the Newfoundland and Labrador Teachers' Association's Virtual Teacher Centre to develop and/or host a suite of online professional development modules and curriculum support materials.

The province invests approximately C$5M annually to support the CDLI. This includes costs associated with e-teachers' salaries, operations, professional development, content and learning object development and digitization, student computers, communications equipment, servers, connectivity, development and maintenance costs, evaluation and research. In addition, a two-year C$15M project is under way to substantially expand broadband access to rural and remote schools and to facilitate migration to video delivery models.

Policy Objectives

The adoption of e-learning as a policy alternative was aimed at broadening program options, providing subject area specialists in areas such as mathematics, science and French, improving student achievement and better preparing rural students for post-secondary study. The policies were specifically targeted towards students living in rural and remote communities where grade level enrolments are typically less that 20 and where access to specialist teachers is difficult due to recruiting and resource issues. In less than three years the CDLI has replaced an antiquated distance education model with one which offers enough flexibility to accommodate significantly greater numbers of students and course options. Course availability now extends beyond the core subjects, reaching into the arts and humanities fields. Other, co-curricular programs sponsored by private enterprise and government departments and agencies, are also now available to rural schools. In effect, the CDLI has found a way to bring programs and resources, normally available only in mid-size and larger schools, to the smallest schools in the province.

Policy Outcomes

E-learning technologies have significantly improved access to broader student programming and provided more diverse opportunities for teacher professional development in rural and remote areas of Canada. In Newfoundland and Labrador, e-learning, at the high school level, has emerged as an important means by which students, disadvantaged by their places of residence, can be provided with an equitable educational program, similar in many respects to the program enjoyed by their urban counterparts. The most significant outcome of the new e-learning model in Newfoundland and Labrador has been greatly increased access to a broad range of high school programming options that did not exist prior to implementation. Table 1 provides data on student enrolment, course offerings and course registrations with the e-learning model as compared with the previous teleconfer-

ence/print based distance education program. Program offerings are increased in mathematics, science, language arts, social studies and the fine arts. Course options have increased in number from 10 to 27 with a planned doubling over the next two years. Even though total provincial course enrolment has dropped in proportion to enrolment decline[7], the relative take-up of e-learning courses has increased significantly. Since the 2000/01 school year enrolment and course registrations have increased by 126% and 135%, respectively, indicating high demand for these courses within rural and remote communities.

Table 1

Senior high school courses, student enrolments, course registration and schools offering distance education/e-learning courses, 2000/01 to 2003/04.

	SCHOOL YEAR			
	2000/01 Telephone Conference Model	**2001/02** Hybrid Program	**2002/03** e-Learning Model	**2003/04** e-Learning Model
Number of Schools Offering Program	75	75	75	95
Student Enrolment	485	362	635	1100
Course Registrations	734	628	958	1724
Courses Offered	10	10	18	27

As enrolment in rural and remote schools continues to decline, the challenges of offering a broad range of high school course options, and of resourcing small schools with subject area specialists will be more pronounced. Correspondingly, the demand for quality instruction via e-learning is expected to increase. A key issue that has been raised by parents and special interest groups in Newfoundland and Labrador relates to the question of whether the CDLI can, in fact, deliver 'quality' instruction, via its suite of e-courses. There is no question that there are limitations to the application of the e-learning model and these are explored elsewhere in this paper. However, early results indicate no difference in performance between students taught in the regular classroom as compared with those taught through the e-learning approach.

Newfoundland and Labrador operates a system of provincial or 'public' examinations. Public examinations are administered in a number of Grade 12 courses and must be successfully written by graduating students to fulfil graduation and post-secondary entry requirements. These examinations are prepared and administered by the province's Department of Education and are marked at a cen-

7. Approximately 8% between 2000/01 and 2003/04 (projected).

tralized marking panel to ensure a common standard of difficulty and marking consistency. Final marks for students are determined using a shared evaluation system based on 50% from the school and 50% from the public examination. Table 2 presents student results and percent passes for a sample of courses offered through the CDLI as compared with regular classroom instruction as of June 2003, the first year of implementation. While it is difficult to draw any definitive conclusions from single-year results with small number of students, average marks and percent passes for students who completed courses through the e-learning model parallel the performance of students who completed the course through traditional classroom instruction.

Table 2

Student performance in Grade 12 courses offered through CDLI as compared with regular classroom instruction, 2002/03.

HIGH SCHOOL COURSE			**STUDENT PERFORMANCE 2002/03** (Combined School and Provincial Examination Results)
Grade 12 French	Regular Classroom (1235)	% pass	96
		avg. mark	70
	CDLI (33)	% pass	100
		avg. mark	72
Grade 12 Advanced Math	Regular Classroom (1529)	% pass	91
		avg. mark	70
	CDLI (111)	% pass	90
		avg. mark	70
Grade 12 Chemistry	Regular Classroom (1456)	% pass	90
		avg. mark	68
	CDLI (46)	% pass	95
		avg. mark	69
Grade 12 Physics	Regular Classroom (1312)	% pass	88
		avg. mark	64
	CDLI (47)	% pass	95
		avg. mark	64

Note: Numbers in parentheses indicate enrolments

Tangible outcomes of the CDLI's programs include benefits for both the individual and for the province in terms of its human capital. For the individual, the benefit of completing advanced and specialized high school courses, and the value of instruction by subject area specialist teachers translates into better preparation for a range of post-secondary programs. From a provincial perspective, higher participation in advanced courses translates into greater levels of post-secondary study and a better educated labour market, while higher participation in fine arts programs supports the province's growing cultural industry. As well, participation in e-learning programs requires the development of skills in multi-media communications technologies that translate into a society that is technologically advanced.

Limitations of the Model

While the e-learning program developed in Newfoundland and Labrador is very robust, program designers recognize there are limitations. Investments in connectivity and the e-learning model have stabilized the program so that connectivity is reliable. However, low bandwidth in some communities has created delivery problems and restricted opportunities to experiment with video delivery. The model also requires significant independent study habits that raise questions about its application for all learners. At present the CDLI is targeting course development towards academic and advanced level program areas. As a result, less academically able students may not derive comparable benefits from this model. While there are plans to introduce some less academically rigorous courses, the model was intended primarily to enhance and broaden the range of courses for academic and advanced students using specialist teachers.

Finally, it should be noted that e-programs are a supplement to regular classroom instruction. For the majority of learners there are limits to the amount of independent study they can undertake and consequently to the number of e-courses that can or should be taught. E-courses generally involve about half-time on-line 'classroom' instruction with the other half of the scheduled class time allocated for independent, self-directed study using web-based materials and tools. This instructional method also requires monitoring at the school level by a cooperating mediating teacher, increasing the resources needed for the program to be effective.

Summary

This paper has explored some of the challenges and ICT-based policy options of addressing the delivery of a broad and equitable educational program in an era of significant rural depopulation and enrolment decline. A new model of distance education (e-learning) is described as a means by which disadvantaged rural students are able to avail themselves of high school courses that are comparable to those offered in larger regional or urban high schools. Early participation and achievement outcomes are discussed together with the limitations of the approach. In short, the initial experience in Newfoundland and Labrador suggests that e-learning can dramatically improve educational access, equity and ICT skills for learners in rural and remote areas, while maintaining student achievement levels, when compared to traditional classroom delivery.

ACKNOWLEDGEMENTS:

The author gratefully acknowledges the assistance of Mr. Wade Sheppard, Director of CDLI for the provision of background material and statistics used in the preparation of this paper and Ms Charlotte Strong who provided useful comments on the final draft. The author also acknowledges the support of Department of Education, Newfoundland and Labrador and the Council of Ministers of Education, Canada.

USING ICT TO IMPROVE THE EDUCATIONAL OUTCOMES OF LOW-ACHIEVING STUDENTS – WHAT TYPES OF POLICIES DO SCHOOLS AND EDUCATION SYSTEM ADOPT?

EVERYONE SHOULD KNOW THE BASICS:

Equalizing Opportunities and Outcomes for Disadvantaged Youths through ICTs in Education

Anthony G. Wilhelm

Benton Foundation, Washington, D.C., USA

Notwithstanding initial policy efforts to establish an inclusive information society, great disparities linger in many OECD countries in access to and meaningful use of ICTs for educational use along economic, social and cultural fault lines. Since we are still in the early stages of the ICT revolution, the confluence of prudent public policy-making, innovative practice and continued technological evolution can serve to expand opportunities and enhance achievement, especially for underserved young people from whom society requires a lifetime of productive work and civic involvement. Policy prescriptions to equalize outcomes for disadvantaged youths through ICTs in education have heretofore focused largely on infrastructure development, investments creating an imbalance between the prevalence of tools and people's capacity to make meaningful use of them. The next phase of policymaking must imbed equitably 21st century literacy in the school-day curriculum while supporting informal learning institutions in extending the learning experience as a community-wide responsibility.

1. INTRODUCTION

Five young commandos plunge down ropes onto the floor below, bent on infiltrating a top-secret enemy missile base. As the Latina commander barks orders at her subordinates, she focused on one eager soldier clutching a laptop computer. She glares at him to enter access codes on the computer in order to snarl the missile guidance system. His stunned look is followed by the skit's comic punch line, "I thought I was only supposed to carry the computer—I don't really know how to use it!"

This 30-second public service announcement aired on Univision, a Spanish-language broadcast station in the United States, and targeted disadvantaged young people unlikely to have home computers. Its aim was to use humor and peer pressure to motivate youths to visit a library or community center to connect to the Internet. A voiceover at the end of the spot entreats, "everyone should know the basics, like how to use a computer." A toll-free telephone number appears connecting youths or their caregivers to a call center where operators search a database of over 20,000 libraries and community centers with free Internet access and training for a nearby location where youths can sharpen their skills.[1]

The "knowing the basics" ad conveys two critical messages to its audience. First, using humor, the ad makes the case that information and communications technologies (ICTs) are essential. The ad's punch line that "everyone should know the basics" suggests ICTs are comparable to traditional literacy and core academic competency as base components of the "DNA" of twenty-first century learning. Individuals, institutions, communities and countries are imperiled to the extent they discount these tools as critical attributes in their development. As services migrate to online environments—and as the demands of modern living expand—individuals, institutions, communities and countries cannot avoid orienting their development around a new set of skills and practices. Decision-makers who assert ICTs should be jettisoned to fuel more critical needs or relegated to the backburner, behind support for other literacy, such as early reading, ignore a stark reality: ICTs are vital to address core public concerns[2] and in sharpening other fundamental arenas of cognition, in ways that are self-directed and customized to diverse learning styles.[3]

Second, the dearth of digital fluency has repercussions for everybody, not just the underclass. Botching the task of jamming an enemy missile guidance system is an uncommon example of the cost of unpreparedness. The evidence is mounting of OECD countries whose future prosperity is at risk given a significant portion of their populations lacks the requisite cognitive and technical capacities to find gainful employment and to manage life successfully. Failing to cultivate the latent talents of the millions of uncredentialled and low-skilled youths and young adults costs societies immensely over these cohorts' lifetimes, jeopardizing economic productivity and political stability.[4] Since we are

1. These ads were part of a public education campaign launched by the Kaiser Family Foundation, AOL Time Warner, the American Library Association, the Leadership Conference on Civil Rights and the Benton Foundation. The database of community technology centers underlying the campaign is maintained by the Digital Divide Network (www.digitaldividenetwork.org), a project of the Benton Foundation. A similar campaign has run in Germany under the umbrella of the "Internet für Alle" campaign, and a database of technology centers is administered by the Berlin-based Stiftung Digitale Chancen (www.digitale-chancen.de).
2. Robert E. Litan and Alice M. Rivlan, eds., *The Economic Payoff from the Internet Revolution* (Washington, DC: Brookings Institution Press, 2001).
3. See Organization for Economic Cooperation and Development, *Knowledge and Skills for Life: First Results from PISA 2000* (Paris: OECD, 2001). Available at http://www.pisa.oecd.org; Educational Testing Service, *Digital Transformation—A Framework for ICT Literacy: A Report of the International ICT Literacy Panel* (Princeton, NJ: ETS, 2002). Available at www.ets.org/research/ictliteracy.
4. Organization for Economic Cooperation and Development, *Financing Education—Investments and Returns* (Paris: OECD, 2003), 19ff. For estimates of the cost of youth educational deficits in the U.S. context, see Marion Pines, ed., *The 21st Century Challenge: Moving the Youth Agenda Forward* (Baltimore, MD: Johns Hopkins University, 2000).

in the early stages of the ICT revolution—in terms of the speed, interactivity, portability and customization of tools in education—effective policies and practice can evolve to expand productivity while simultaneously enhancing social inclusion.

In educational settings worldwide, ICTs are playing an expanding role—from mundane backend procurement to the extraordinary possibilities of the virtual school. Weaving ICTs into educational practice remains a relatively young enterprise, its potential largely untapped in renewing teaching and learning.[5] Technologists forecast an emerging world of pervasive, portable networked computing, customized tools and intelligent machines that will soon make the world of the desktop computer appear antiquated. While these tools promise breakthroughs in the manner and degree to which lifelong learning occurs, concerted action is required among governments, civil society organizations and private enterprise to ensure new tools and devices do not exacerbate divides in learning opportunities and outcomes within and between communities and countries.

Most OECD countries face daunting challenges at the dawn of the new century to cultivate learning societies meeting the acute needs of disadvantaged populations. Young people with learning disabilities, immigrants, the indigent, victims of war and civil unrest, the disaffected and the incarcerated can all benefit from expanding access to and effective use of ICTs. Groups pushed out of formal schooling owing to social stigma, such as pregnancy, or bullying due for instance to sexual orientation have found more supportive settings for learning in cyberspace, such as the successful NotSchool.net project in the United Kingdom.[6] Incarcerated youths and those under court supervision in the United States are telling their stories with digital cameras and multimedia, building self-esteem and restoring their social footing in an environment in which many feel marginalized and disposable.[7] And significant rates of youth depression and disaffection in the former Soviet Union and Eastern Europe have led to promising experiments with individualized interactive software to approach, analyze and treat social anxiety in a safe environment.[8]

In each of these experiments, outcomes have improved dramatically for youths who, for whatever reason, languished in formal schooling. Importantly, from a policy perspective, entrepreneurial leadership promoting alternative approaches to learning have demonstrated success, thus meriting recurring support from governmental and other large funding sources. In this respect, alternative approaches are becoming mainstream due to persuasive change agents breaking through with support from public and private underwriters. These programs—including creative after school programs—have pressured monolithic school systems to change, with a new demand for quality and innovation coming from parents, students and concerned citizens who have been energized by what they have seen. The Intel-supported Computer Clubhouse network, for example, has established modestly successful creative after school programs where disadvantaged teenagers work with mentors to design and create robotics, art, music and video using technology in collaborative, supportive environments.[9] Given these experiences are often foreign to school-day learning rituals, stakeholders

5. U. S. Department of Commerce, 2020 Visions: *Transforming Education and Training through Advanced Technologies* (Washington, DC: U.S. Department of Commerce, 2002). Available at http://www.ta.doc.gov/reports/TechPolicy/2020Visions.pdf.
6. Notschool.net is an online research project looking at ways of re-engaging young people of school age into an environment in which they are able to develop new ways of learning. It is essentially a 24/7 virtual community, offering young people the opportunity to develop their self-esteem and expand self-directed learning, achieved through the support of tutors, mentors and the strategic use of ICTs.
7. See Street-Level Youth Media (www.street-level.org), a program educating Chicago's inner-city youths—including gang members and youths under court supervision—in media arts and emerging technologies for use in self-expression, communication and social change. Street-Level programs build self-esteem and critical thinking skills for urban youths historically neglected by policymakers and mass media. Another project, called *The Beat Within*, is a weekly web publication relating the voices of young people from within juvenile hall. This outlet allows detained young people to express feelings of isolation and hope in connecting to a larger community within and without (http://pacificnews.org/yo/beat/about.html).
8. Comments made by Andrei I. Podolskij, professor of cognitive development at Moscow State University, at the Teens and Technology Roundtable II, Jacobs Foundation Communication Center, Oehningen, Germany (7–8 November, 2002).
9. Tisha Pryor, and others, *Evaluation of the Internet Computer Clubhouse Network: Year 2 Report* (New York, Center for Children & Technology, 2002). Available at http://www2.edc.org/cct/admin/publications/report/Intel_CCN02.pdf.

are beginning to build bridges—pedagogical, technological and social—between school-day and after school ecosystems.

Formidable obstacles must be overcome to take to scale some of these promising programs, not the least of which is overcoming the pervasive discrimination and marginalization facing many subgroups in society. More broadly, youth stereotypes require revision with an eye toward treating youths as critical assets and responsible partners in building the learning society.[10] Many of these corrosive frames of reference (e.g., the prevailing mass media depiction of youths as delinquents not as future assets) impinge on the allocation of resources directed at the edification of hard-to-serve young people. In this climate raising performance levels and softening the impact of economic disadvantage and social stigma will require us seeing youths in a new light and in allocating resources accordingly. Programs such as the Intel Computer Clubhouse network, Notschool.net and others honor youths as future assets with huge untapped potential, unlocked in part through experiential, project-based learning.

2. THE CHALLENGES OF RAISING PERFORMANCE

In many instances, ICTs are introduced into educational systems unprepared to integrate them effectively to improve performance, particularly for low-achieving learners. Outworn organizational structures and human-capacity deficits often cut against the grain of forward progress in e-learning/m-learning. Poor teacher morale and qualifications coupled with shortages of material and educational resources also hinder the effective integration of ICTs—and ultimately student performance.[11] Low-achieving students with limited exposure to computing devices are clearly less likely to benefit from them than students with greater time on task, all else being equal. The quality of physical infrastructure, finally, affects technology diffusion, including electrical upgrades and building maintenance.[12] Parachuting ICTs into these environments without addressing underlying issues of organizational readiness, continuous professional development and infrastructure would be precipitous. A significant period of time is required to integrate ICTs across academic subjects—allowing for the development of technology plans, management training and professional development—a painstaking process requiring patience on the part of decision-makers as these changes ingrain on institutional cultures.

More often than not teachers feel unready to integrate ICTs in the classroom.[13] Few opportunities exist for continuous learning for many time-crunched teachers. In high-poverty school districts in the United States, many teachers lack the pedagogical, academic and class-management skills to instruct low-achieving students. And widespread teacher shortages, where demand outstrips the supply of new teachers from training schools, thwart the imperative to raise the quality of the teaching cohort. In initial teacher training, moreover, ICT instruction is patchy, at least in Europe[14] and the United States.

10. See Franklin D. Gilliam, Jr. and Susan Nall Bales, "Strategic Frame Analysis: Reframing America's Youth," *Social Policy Report* XV: 3 (2001), 1. Available at http://www.srcd.org/sprv15n3.pdf. According to the authors, the three most frequently reported topics of youth news on local newscasts were crime victimization, accidents involving young people and violent juvenile crime.
11. *Knowledge and Skills for Life, chap. 7.*
12. Andy Carvin, ed. *The E-rate in America: A Tale of Four Cities* (Washington, DC: Benton Foundation, 2000), 17. Available at http://www.benton.org/e-rate/e-rate.4cities.pdf.
13. Education Week, "Capacity to Use Technology: Teacher Proficiency State Data Table," *Technology Counts 2002: E-Defining Education* 21:35 (2002), 62. Available at http://www.edweek.com/sreports/.
14. *Eurydice, Basic Indicators on the Incorporation of ICT into European Education Systems—2000/01 Annual Report (Brussels: Eurydice, 2001), 26.*

It is not uncommon for pupils to express frustration because they can outperform their instructors with the tools.[15] Rather than a source of tension, young people's fluency with technology should be channeled into creative mentoring programs where youths tutor their peers and seniors alike, such as the successful Senioren @ns Netz program in Leipzig or a promising experiment in Bonn called Computer-Training for Underserved Youths [Computer-Training für benachteiligte Jugendliche].[16] In after school and community-based programs, catchments for many disillusioned and under-performing youths, organizational readiness and staff training are quite uneven (as are public and private budget commitments), with clear implications for introducing ICTs into educational and social work aimed at disadvantaged youths. Organizations such as EDC's YouthLearn in the United States and the Digital Chances Foundation [Stiftung Digitale Chancen] in Germany have developed manuals and courses for youth center staff, the latter also running a telephone hotline to provide technical assistance where appropriate.[17]

While the challenges of professional development are daunting, examples of successful practice do exist. Beginning in 1997, the state of Idaho in the United States required 90 percent of all certificated personnel in a school to pass one of three state-approved technology assessment models by 2001. Through robust collaboration with state colleges of education in the preparation and inservice training of teachers as well as creative integrating of technology into instructional practices this goal has been achieved. With 15,000 teachers in geographically dispersed districts in the state and only 20 training staff within the colleges, creative distance programs and train-the-trainer models proved successful in meeting the state government's proficiency goals for teachers.[18] In Finland, moreover, according to Jouni Kangasniemi at the Finnish Ministry of Education, approximately 20 percent of teachers receive government-funded advanced in-service training every year, a 2.5 million euro program complementing institutionally supported professional development.

In most "networked-ready" economies (as the World Economic Forum describes economies poised to reap dividends in productivity due to ICTs),[19] substantial investments in infrastructure preceded any serious initiative to train teachers effectively in their use. The goal to wire every classroom was ensconced in national policymaking in the United States beginning in 1994 with the launch of a variety of public and private initiatives. Training and curriculum development have hitherto played catch up. In the United States[20] and virtually every European country except Finland,[21] federal infrastructure expenditures greatly outpace investments in human-capacity building. In short, technology investments often trump training the cadre of teachers who will effectively integrate ICTs.

In this milieu, the theme of ICTs and equity is of critical importance to policymakers and other decision-makers owing to the fact that technology can provide a platform to equalize access to critical resources and opportunities to learn. Article 26 of the Universal Declaration of Human Rights states that everyone has a right to an education directed to the full development of the human per-

---

15. Douglas Levin and Sousan Arafeh, The Digital Disconnect: *The Widening Gap Between Internet-Savvy Students and Their Schools* (Washington, DC: Pew Internet and American Life Project, 2002). Available at http://www.pewinternet.org/reports/pdfs/PIP_Schools_Internet_Report.pdf.
16. See http://www.seniorenansnetz.de and http://www.digitale-chancen.de/content/projects/indexdeep.cfm?key=278.
17. See www.youthlearn.org and www.digitale-chancen.de.
18. John D. Mergendoller, *An Analysis of the Progress of the Idaho Educational Technology Initiative in Meeting Goals Established by the Idaho Council for Technology in Learning* (Novato, CA: The Buck Institute for Learning, 1999). Available at http://www.sde.state.id.us/Vault/DocVault/TechS/Mergendoller_Report_2000.pdf.
19. World Economic Forum, *Global Information Technology Report, 2002–2003: Readiness for the Networked World* (New York: Oxford University Press, 2002).
20. In the arena of K–12 technology expenditure in the United States, for example, of the $7.2 billion spent in fiscal year 1998 (approximately 30% of which came from the national government), about $51 million went for software and $29 million—*or about four percent*—for training expenses and release time for teachers. See Ronald Anderson and Henry Jay Becker, "School Investments in Instructional Technology," *Teaching, Learning and Computing: 1998 National Survey* (Irvine, CA: Center for Research on Information Technology and Organizations, 2001), 5. Available at http://www.crito.uci.edu/tlc/findings/report_8/REPORT_8.PDF.
21. *Basic Indicators, 10.*

sonality. In order to ensure equal educational opportunity, adequate facilities and resources, technological and otherwise, are required—as well as a shared belief in equal dignity and respect, a telltale for which is conviction in the inherent ability of all peoples to learn. In the American context, recent debates over school equity have proceeded along two fronts: the "resource parity" argument suggests that per-pupil expenditures ought to be roughly equal and flow from a fair tax or revenue model; and the educational "adequacy" approach looks at resource inputs (e.g., teacher pay, class size, facilities) and student performance outcomes as bellwethers for courts to determine whether school systems are inadequate and thus unconstitutional.[22]

Indicative of the raison d'être for civil rights and equity movements are wide achievement gaps in many OECD countries, differentials particularly acute in Germany and the United States, for example, where substantial variation in reading achievement is evidenced between the highest one-quarter of students and the lowest.[23] The dual challenge is that student performance is strongly correlated with economic, social and cultural status[24] as is access to and frequent use of ICTs.[25] One might expect in the short term, therefore, that ICTs would contribute to a widening, not a shrinking, of the achievement gap unless successful programs are ramped up providing motivation and technical fluency while simultaneously offering remediation in cognitive skill development and core academic subjects. Without comprehensive and systemic policy strategies for e-learning, it remains to be seen at the macro level how strategic investments in ICTs may mitigate these gaps. Clearly targeted interventions are necessary to address at-risk young people's complex emotional, social and academic needs (including in-school and out-of-school young people, the latter largely underskilled and underemployed), and ICTs can play a vital role in facilitating these interventions.[26] Yet some policy leaders are increasingly normalizing instructional approaches and assessments[27] at this critical juncture in which ICTs have begun to exhibit promise in customizing solutions to learners' diverse cognitive and environmental profiles.[28]

The good news is that many young people across the board are attracted to technology: it sparks their curiosity in learning and may even provide a "turning point"—that is, a healthy discontinuity in the experience of social disadvantage—as professor Alexander Grob from the University of Bern has argued. At the micro level, innovation has yielded transformational results for many underserved youths, with the promise of closing the achievement gap for the slice of learners impacted by good programs.[29] Technology has been instrumental in expanding self-esteem and feelings of self-effica-

22. Marilyn J. Gittell, ed. *School Equity: Creating Productive Schools in a Just Society* (New Haven: Yale University Press, 1998).
23. *Knowledge and Skills for Life*, 57–58.
24. Ibid., 187–188.
25. Ibid., 118.
26. Kay Livingston, "Disadvantaged Teenagers and Technology: Summary Results from a Transatlantic Research Inventory," *Toward Digital Inclusion for Underserved Youth* (Washington, DC: Benton Foundation, 2001), 33–40. Available at http://www.benton.org/ttr/TeenTechBooklet.pdf.
27. For a riveting account of the tension between traditional accountability measures and those made possible through small schools and smart use of ICTs, see Elliot Washor and Charles Mojkowski, "Accountability in Small Schools," *Education Week on the Web* (9 April 2003). Available at http://www.edweek.com/ew/ewstory.cfm?slug=30washor.h22&keywords=elliot%20washor (registration required). As the authors suggest, "most small schools feel a special responsibility to be accountable to the community, families, students, and themselves for each one of their children. Not only are they concerned about not leaving any child behind, but their practice of personalizing their schools with advisories, learning plans, internships, exhibitions, professional development, and portfolios aims to ensure that no child is left unknown, as a learner and as a person."
28. Howard Gardner, *Intelligence Reframed: Multiple Intelligences for the 21st Century* (New York: Basic Books, 2000).
29. Project TELL traced the effects of home computers with network access on the lives of disadvantaged students and their families over a seven-year period. Researchers followed a group of New York City public school girls and boys from low-income, minority families in segregated inner-city neighborhoods. 125 middle-school students scoring below proficiency on their standardized reading test were chosen with an appropriate comparison group chosen from the same middle school. Results were not universally encouraging, particularly for severely at-risk students. For a subset of the treatment group performance gains over four years were significant, and each person in the subgroup eventually graduated from high school and enrolled in local colleges. William Kornblum, City University Graduate Center, "The Digital Divide and the Severely At-Risk Student," unpublished paper delivered at the Teens and Technology Roundtable I, Benton Foundation, Washington, DC (4–5 October 2001).

cy.[30] Successful practice, where leadership interventions break the cycle of poor performance and underachievement using ICTs, however, are exceptional, enveloping only a small portion of the millions of disadvantaged youths and young adults in OECD countries. Where inspired leadership has met with success usually pivots on a concentrated, systemic approach, empowering staff and students to co-conspire in school renewal. Given that ICTs are capital-intensive investments, these reforms require dedicated funds (a combination of reallocated and new revenues) through a mix of constant public and private sources.

One example from the United States of a school district undergoing marked transformation due to ICTs is the Union City School District in New Jersey, a district lying across the river from New York City. Robust collaborations from a variety of partners, including deep community partnerships, as well as a strong steering role for staff, led to the decision over several years of planning to implement comprehensive curricular reform, major scheduling changes, increased in-service training and an infusion of technology into homes as well as schools to enhance cooperative learning.[31] A school district that in 1989 was below state averages in attendance, dropout and transfer rates as well as standardized test score performance was transformed: today its eighth-grade readiness test results are among the highest in the state.

The level of technology infusion occurring in Union City could not have happened without dedicated resources. As Fred Carrigg, executive director for academic programs for the district declared, "none of this happens without money, but a lot of that can be and should be a restructuring of how money is expended."[32] First, in 1989 the state courts found the funding and resource levels for schools in poor communities to be inadequate and hence unconstitutional. The subsequent increase in per-pupil expenditure allowed Union City to experiment with new approaches to learning, including implementing comprehensive curriculum reform focusing on a literacy curriculum to sharpen thinking, reasoning and collaboration skills. Second, other state and federal funding for high-poverty communities were also leveraged. And, finally, Bell Atlantic (now Verizon, the largest telecommunications company in the United States) made substantial hardware investments, in schools and in homes, in order to explore how pervasive technology diffusion would impact learning.

One lesson to draw from the U.S. experience in general and from Union City in particular is that successful policy approaches need to be comprehensive and holistic: they must empower stakeholders and address youth development in its broadest sense. Union City leadership turned the established order on its head—in deputizing staff to make decisions at the school level; in altering the cadence of the school day; in building bridges to the home and broader community—such that students from the toughest backgrounds excelled in this new environment. In the United States and Germany, the desire to develop more comprehensive and scalable learning experiences has focused on extending the school day to allow youths and the community to access facilities, including ICTs, in the after school environment. The 21st Century Community Learning Centers program in the United States and a new initiative in Germany to extend school hours in the afternoon both address the challenge of enhancing student achievement while also searching for more inclusive approaches to bridge the world of formal and community-based learning.

Comprehensive and sustainable approaches have proven elusive due to some combination of the following inauspicious circumstances: turnover in leadership; uncertainties in budgets and prioriti-

30. Alexander Grob, "Improving Learning and Professional Perspectives of Disadvantaged Adolescents by Peer Tutoring," Presentation given at the Teens and Technology Roundtable II, Jacobs Foundation Communication Center, Oehningen, Germany (7–8 November, 2002). Available at http://www.digitale-chancen.de/transfer/assets/102.pdf.
31. Center for Children and Technology, *The Transformation of Union City: 1989 to Present* (New York: EDC Center for Children and Technology, 2000). Available at http://www2.edc.org/CCT/admin/publications/report/uc_transform00.pdf.
32. Diane Curtis, "Urban Renewal: The Union City Turnaround," *Edutopia* (spring 2003), 8.

zation; and fragmentation of programs and policies, leading to unevenness in the maturation and effectiveness of programs across the board.

3. CROSS-COUNTRY COMPARISONS: FINLAND, GERMANY AND THE UNITED STATES

Can ICTs be drivers to close achievement gaps and address the range of needs of underserved youths as a matter of effective national policymaking? Or is this fated to be a piecemeal exercise, dependent on the exigencies of local circumstances, washed along by the current of inexorable social forces? I will explore national policymaking in three OECD countries—Finland, Germany and the United States—for signs that ICTs can be an important component in strategic interventions in the downward spiral of social exclusion afflicting too many of our young people. Germany and the United States suffer from significant social divides: the former due in part to reunification effects; the latter to historic discrimination against racial and ethnic minorities. Do we witness signs that ICTs are mitigating these gaps? Finland is juxtaposed to Germany and the United States as a country with a relatively modest variance in performance across a range of economic, social and cultural variables. Have ICTs played a role in achieving this egalitarian state of affairs?

3.1. Germany and the United States: Closing the Achievement and Technology Gaps?

In cities in the United States and Germany, demographic shifts in urban centers, coupled with job flight to the suburbs and the loss of manufacturing jobs due to automation and business migration signal tumultuous times for low-skilled urban youths.[33] Successful strategies to mitigate these inequalities focus on macro-level fiscal policies, such as negative tax policies, broadening educational and workforce preparation opportunities (where an adequate tax base and public support for education exist) and cultivating an attractive business climate for entrepreneurs and innovators to take root and blossom.[34] In short, promising government policy embarks on initiatives to raise performance while softening the impact of socioeconomic disadvantage. One favorable lesson from Germany, given its low youth unemployment rate relative to other OECD countries, is to get youths into jobs early and to keep them employed.[35]

Germany and the United States possess significant achievement gaps, and it is worth examining whether ICTs are mitigating these differences, tools in effectively equalizing educational opportunities and outcomes. One can adduce striking examples of effective practices: Union City or the Web.Punkte project in Bremen, Germany is a good example. At the macro level, various support programs such as the E-rate in the United States and Germany's New Media in Education program aim to stimulate ICT access and effective use in schools. Various clusters of private-sector investments, such as Intel's Computer Clubhouse program in the United States, have proven crucial. In Germany Deutsche Telekom and the Federal Ministry of Education and Research initiated a public-private venture in 1995 called "Schulen ans Netzt," offering 10,000 schools free internet access (for one year) and one multimedia PC. So many programs exist, but what difference have they made?

33. David G. Blanchflower and Richard B. Freeman, eds., *Youth Employment and Joblessness in Advanced Countries* (Chicago: University of Chicago Press, 2000).
34. Andreas Breiter, "Regional Learning Networks – Building Bridges Between Schools, University and Community," *Informatics and the Digital Society: Social, Ethical and Cognitive Issues, Tom van Weert and Robert K. Munro, editors* (Boston: Kluwer, 2003).
35. *Youth Employment and Joblessness*, 403ff.

Strategies to harness the potential of ICTs for educational advancement in OECD countries began in earnest in the mid 1990s. The Clinton Administration ushered in the National Information Infrastructure (NII), promising to connect institutions and streamline service delivery. Between 1993 and 2001, national funding in the arena of educational technology and universal service soared from U.S. $23 million to U.S. $3.5 billion,[36] almost all of which was targeted at economically, socially and culturally marginalized communities. Categorical funding has since declined,[37] and state funding has retrenched;[38] yet overall federal education funding has increased significantly, including more funding for teacher training.[39] Other countries entered the fray at roughly the same time. In Finland the first national information-society strategy document was written with the backdrop of the recession of 1993–1994. At this time in Germany, Chancellor Kohl was focusing more on digital television than on computerization.[40] Four years later in 1998, Chancellor Schröder, in his very first statement as Head of Government, underscored the central importance of spreading the fruits of the information society to all residents. The prevailing educational technology doctrine came to be premised on accomplishing three interrelated goals, what Vice President Gore called the Internet ABCs: achieving universal **Access** to ICTs; expanding **Basic** training for teachers; and ensuring relevant **Content** was produced to optimize network use. Similarly, the German model was predicated on three pillars to support the modern school: infrastructure, competence and content.[41]

In implementing this three-pronged approach, it remained unclear what an appropriate balance among the three would resemble in terms of funding and sequence, particularly to diffuse knowledge and skills, not just technology. In the United States this question was answered de facto by the passage of the Telecommunications Reform Act of 1996 in which an important new provision called the E-rate provided significant resources for telecommunications infrastructure diffusion. The program's purpose is to expand universal service to essential communications tools to schools and libraries according to economic need and geographic isolation. Operating on a sliding scale with recipients (e.g., state education agencies, school districts, individual schools and library systems) eligible for up to a 90 percent discount on certain telecommunications services, including telephony and Internet service, E-rate discounts vary depending on the degree of poverty and rurality.[42] Eligible educational institutions apply for the discounts or reimbursements from a nongovernmental organization set up to administer the fund.

The priority for much of this funding was in meeting the goal of modernizing infrastructure in schools, a goal now accomplished in a quantitative sense for both schools and libraries in the United States, the latter due in large measure to the work of the Bill and Melinda Gates Foundation. With such a large investment targeting infrastructure development, school systems quickly scrambled to train teachers and develop curriculum, tasks falling by and large to local, regional and state educational agencies, as we shall see.

School systems with the expertise, economies of scale and/or flexibility to develop technology plans tied to curricular and school reform goals were often able to garner enough public and private support

36. Anthony G. Wilhelm, "Leveraging Sunken Investments in Communications Infrastructure: A Policy Perspective from the USA," *The Information Society* 19:2 (May 2003).
37. Norris Dickard, "Federal Retrenchment on the Digital Divide: Potential National Impact," *Policy Brief No. 1* (Washington, DC: Benton Foundation, 2002). Available at http://www.benton.org/policybriefs/brief01.pdf.
38. See Corey Murray, "Budget Ax Falls on School Tech Programs" *eSchool News Online.* Available at http://www.eschoolnews.com/news/showStory.cfm?ArticleID=4407.
39. See http://www.ed.gov/.
40. Herbert Kubicek, "Multimedia: Germany's Third Attempt to Move to an Information Society," *National Information Infrastructure Initiatives: Vision and Policy Design,* Brian Kahin and Ernest Wilson, editors (Cambridge, MA: MIT Press, 1997).
41. Federal Ministry of Education and Research, *Online-Offline: IT in Education* (Berlin: BMBF, 2000), 7. Available at http://www.bmbf.de/pub/itkon_e.pdf.
42. For an overview of the program, see the Universal Service Administrative Company's website at http://www.sl.universalservice.org/overview/.

to begin to implement programs with the wherewithal to affect student performance markedly. As was clear from the Union City example, ubiquitous communications tools linking the school to the larger community, including the household, expanded learning—and the accountability for learning—to the larger community, greatly increasing parent and caregiver involvement in the educational enterprise.

In September 1999 Germany released its comprehensive strategy for the information society, a master plan called "Innovation and Jobs in the Information Society of the 21st Century."[43] The program defines specific targets through 2005, including increasing Internet subscribership, equipping schools with multimedia PCs, developing a leading position worldwide in education software development and integrating the new media into a renewed approach to lifelong learning.[44] Not unlike other countries, installing hardware was a priority, propelled by partnerships with industry (e.g., Deutsche Telekom provided ISDN and some DSL connections to schools), including the creation of a marketplace for new and second-hand PCs.

Popularized and promoted by Chancellor Schröder in 2000, "the Internet for All" [Internet für Alle] 10-point campaign aimed to articulate the benefits of ICTs through public-education campaigns, thereby countering the dangers inherent in unwittingly fostering digital inequality by targeting specific underserved groups: senior citizens, people with disabilities, immigrants, women and the indigent. A national outreach program, however, is tempered by the fact that schools and other learning institutions are run by local governments, churches and nonprofit organizations. For the most part, funds were not provided to link local activities to the national campaign, let alone to sustain their efforts.

What the Internet for All campaign found was Internet "objectors" [Internet-Verweigerer] cover almost half of the German population over 14 years old. This category of objectors is heterogeneous, comprising diverse demographic groups with differing rationales for not using the Internet.[45] A large percentage of non-German speakers are offline; yet scant government and social service information is available in a non-German language. Therefore segmented and specialized approaches are necessary to motivate them to use the Internet, approaches most likely to develop successfully in localities, with support from local, state and national sources.

The targets of the Internet for All campaign in Germany mirror the groups identified as being on the wrong side of the digital divide in the U.S. Government's 1999 report, *Falling through the Net*. At the time, Assistant Secretary of Commerce Larry Irving called the issue of the digital divide a civil rights imperative for our times,[46] and the U.S. Government leveraged its power to provoke widespread private-sector activity. Today the latest surveys on Internet use in the United States are not dissimilar from the German findings: Forty-two percent of Americans say they do not use the Internet, many either evading the technologies by having others navigate the tools for them or dropping out of cyberspace due to economic hardship or disillusionment.[47] The United States and Germany are surely not alone in experiencing a flattening of take-up and demand for services, due not only to the deflationary economic climate but to the perceived lack of relevant content and curriculum meeting diverse information and communicative needs.

The German master plan calls on the private sector to do its part in accelerating the diffusion of ICTs in Germany. Unlike in the United States where private-sector collaboration was decentralized

43. Federal Ministry of Economics and Technology and Federal Ministry of Education and Research, *Innovation and Jobs in the Information Society of the 21st Century* (Berlin: BMWI and BMBF, 1999). Available at http://www.bmbf.de/pub/inno21e.pdf.
44. *Innovation and Jobs, 9.*
45. TNS EMNID, "Der Verweigereratlas—Basiserhebung" (Bielefeld: TNS EMNID, 2001). Available at http://www.digitale-chancen.de/transfer/downloads/MD8.pdf.
46. U.S. Department of Commerce, *Falling through the Net* (Washington, DC: U.S. Department of Commerce, 1999), xiii.
47. Amanda Lenhart et al., *The Ever-Shifting Internet Population: A New Look at Internet Access and the Digital Divide* (Washington, DC: Pew Internet & American Life, 2003), 3. Available at http://www.pewinternet.org/reports/pdfs/PIP_Shifting_Net_Pop_Report.pdf.

(with the notable exception of the CEO Forum and a few other coordinated efforts), Chancellor Schröder attempted to cohere private-sector activities by chairing the Germany 21 Initiative [Deutschland 21] and offering companies a discrete way to contribute. The ambitious goal of 20,000 long-term school sponsorships was established to improve ICT use in the educational system, including a computer market for new and used PCs for schools;[48] only a fraction of these sponsorships came to pass. The D-21 sponsorship package included planning, installation, training and maintenance in what the providers call a "no-worry packet" with the provision of lasting support and know-how.[49]

Following their respective national information society roadmaps, both countries witnessed significant increases in ICT penetration in elementary and secondary schools. In terms of sheer diffusion, by early 2002 Germany reached 23 primary education students, 17 secondary education students and 13 vocational education students per Internet-connected computer.[50] At the same time in the United States, there were six primary education students and four secondary students per instructional computers connected to the Internet,[51] putting the United States on par with Nordic countries, and approximating the ratio some American experts consider optimal from an educational viewpoint.[52]

The German federal initiative necessitated the 16 state governments developing their own complementary programs. Currently every state is running ICT programs and Germany recently took up equipping schools. Since such an investment needs to be justified, the poorest and smallest of the German states, Bremen, embarked on a comprehensive approach to ICT-infused learning called Web.Punkte. Launched in the cities of Bremen and Bremerhaven, in league with Deutsche Telekom, Web.Punkte is a two-year, 2 million euro experiment in 25 schools, opening their computer labs afternoons for students and community members. The initiative's overarching goal was to build bridges between schools and the larger community (e.g., developing cooperation among lifelong learning institutions), including attracting infrequent ICT users, such as immigrants and seniors. Students of diverse backgrounds from the Web.Punkte schools, moreover, were trained as "web scouts," receiving certification as peer mentors to provide instruction to patrons. A preliminary program evaluation describes a program exhibiting promise, with a need to expand cooperation with a larger network of learning and social service organizations to increase the visibility and the relevance of sites to community members.[53]

The U.S. Department of Education's Preparing Tomorrow's Teachers to Use Technology grant program (PT^3)[54] for several years supported high-quality reforms in teacher preparation programs for the purpose of increasing the knowledge, skills and abilities of prospective teachers to use technology efficiently in their future teaching practices. The program responded to the dilemma that elementary and secondary schools are now universally connected to the Internet, yet many teachers still feel uncomfortable using technology in their classrooms. The program was eliminated in 2002. A program in Germany to test the introduction of e-learning materials in everyday classrooms called New Media in Education will run until 2004 and is funded by the Federal Ministry of Education and

48. See www.marktplatz-fuer-schulen.de.
49. *Online-Offline, 8*.
50. Federal Ministry of Education and Research, "IT-Ausstattung der allgemein bildenden und berufsbildenden Schulen in Deutschland" (Berlin: BMBF, 2002), 7. Available at http://www.bmbf.de/pub/it-ausstattung_der_schulen_2002.pdf.
51. U.S. Department of Education, *Internet Access in U.S. Public Schools and Classrooms: 1994–2001* (Washington, DC: National Center for Education Statistics, 2002). Available at http://nces.ed.gov/pubs2002/internet/.
52. President's Committee of Advisors on Science and Technology, "Report to the President on the Use of Technology to Strengthen K-12 Education in the United States" (Washington, DC: Office of Science and Technology Policy, 1997), §3.1. Available at http://www.ostp.gov/PCAST/k-12ed.html#3.h.
53. Andreas Breiter, "Public Internet Usage Points in Schools for the Local Community: Concept, Implementation and Evaluation of a Project in Bremen, Germany," *Education and Information Technologies* (forthcoming).
54. For more detail about the now defunct program, see http://www.ed.gov/teachtech/.

Research. The use of new pedagogical methods—online teacher preparation, electronic portfolios and Internet-based teacher programs—are all innovations to assist teachers if they have the time and support to absorb these approaches.

It is critical that innovative pedagogical or didactic practices and methodologies be supported, since ICTs portend a robust learner-centered approach to education and instruction. In late 2002 the Bill and Melinda Gates Foundation funded the development of alternative upper-secondary schools for underachieving adolescents and young adults. Outside-the-box approaches were encouraged predicated on small class sizes and pervasive use of ICTs to customize and extend the learning experience. Personalized approaches have shown to enhance performance, and asynchronous extranets, linked with the broader community, can mitigate the inertia of socioeconomic disadvantage, creating virtual support networks and cooperative learning partnerships to assist students and their caregivers in their journeys as learners.[55]

3.2. The Finnish Model

At the end of 1998, the Ministry of Education in Finland set up a working group to prepare a proposal for a national strategy for education, training and research in the information society for 2000-2004. This national strategy document is a sequel to the previous five-year plan adopted in 1994.[56] In the late 1990s Finland devoted substantial resources to diffuse ICTs in schools and other learning institutions, including modernizing a well-established library system.[57] The government's partnership with ICT companies, including Nokia, to promote mobile communications as an educational tool is promising. Since Finland has the highest mobile phone penetration in the world[58]—approaching the diffusion of color televisions—it may well become a bellwether among many efforts within OECD countries to promote portable, wireless tools to improve collaborative learning.

Finland is one of the few OECD countries spending at least as much on training and research at the national level as on infrastructure.[59] In 1999 teaching techniques across universities and other educational institutions were heterogeneous, with only about one-fifth of educational staff applying ICTs extensively to support teaching.[60] Today the picture looks quite different. Since the Finnish Ministry of Education launched the Teacher Training Project (OPE.FI) over one-third of teachers have received advanced in-service training, according to Ritva-Sini Merilampi, Counselor of Education within the Ministry. In terms of research and development, Finland is leveraging its competitive advantage in telecommunications applications to explore pervasive modes of lifelong learning in the information society[61] with an eye toward cooperative learning. Open-source tools are being tested in Finnish schools, and open learning environments are encouraged, expanding self-directedness, solidarity, teamwork, communications and the possibilities of collective decision-making in environments that flatten the distinctions between experts and laypeople.

55. See footnote 26.
56. Finnish Ministry of Education, *Education, Training and Research in the Information Society: A National Strategy for 2000-2004* (Helsinki: The Ministry of Education, 1999). Available at http://www.minedu.fi/julkaisut/information/englishU/welcome.html.
57. Finnish Ministry of Education, *A Wide Range of Culture and Quality Information Retrieval in the Library: The Salient Points and Proposals in the Finnish Library Policy Programme 2001–2004* (Helsinki: The Ministry of Education, 2001).
58. Juha Nurmela, Lea Parjo and Marko Ylitalo, *A Great Migration to the Information Society: Patterns of ICT Diffusion in Finland in 1996–2002* (Helsinki, Statistics Finland, 2003), 14 (figure 2.5).
59. *Basic Indicators, 10.*
60. *Education, Training and Research, §1.1.*
61. *A Great Migration*, 12 (figure 2.3), 24. According to the report, "The Finnish national economy relies heavily on the ICT sector, both in terms of value added and employment: on these measures there is no other oecd country where the ICT sector is more important."

Finland has achieved an overall high-standard educational system and a high level of general education in the population, stemming from a national development strategy from the 1960s onward to create new universities all around the country. The impact of this policy—coupled with a strong link with regional economic development and research—have sustained an egalitarian society with a high standard of living in which the information society and the welfare state manage to coexist relatively amicably.[62] Promoting a culture of lifelong learning, supported by strong links among diverse learning institutions (e.g., schools, libraries, workplaces and homes) is a palpable vision. Education policy fosters a close contact with working life, a practice linked to increased retention rates and skills-building among disadvantaged young people. The imperative also exists to build educational support structures extending throughout life, in part through the de-compartmentalization of traditional learning arenas. Breaking down the silos separating home, school, community and work contributes to a deepening of learning opportunities beyond the confines of formal institutions and preset course offerings. Increasing parental involvement in young people's educational lives is a critical lever to amplify learning outside of school walls for disadvantaged youth. Expanding community accessibility to technology and training through libraries and after-school programs is also important, as is introducing youths to the working world.

Finland's commitment to equal educational opportunities so that no region or subgroup in the country lags behind others is a central component of its information society strategic action plan. With the near universal diffusion of mobile phones in Finland, even in remote regions,[63] the emergent learning society bodes well as mobile phones become the "central processing units" (CPUs) for information and communications exchange as the naught-decade unfolds. Computer and Internet access and use do tend to vary across regions in Finland with digital divides separating urban centers from rural areas as well as along educational lines with over 80 percent of Finns with a tertiary education using the Internet compared to under 50 percent of those with only a basic education.[64] But unlike other countries where disinterest is a major barrier to Internet use, many Finns (with the exception of middle-aged and senior citizens in remote regions) say they do not require home connectivity because they are afforded access on the job, in the neighborhood library or at a nearby cybercafé.[65] These gaps appear less pronounced than in most other OECD countries, although a concerted effort to reach seniors and poor residents in remote areas of Finland remains a significant policy challenge.

In Finland student achievement tends to be relatively unvarying across geography and economic strata,[66] suggesting underlying macro-level social and educational policies are fundamental in nurturing an egalitarian ethos. Indeed, the notion that ICT diffusion and purposes tend to amplify preexisting institutional goals, strategies and relationships appears to have merit in the instance of Finland where regional development over several decades coupled with rapid modernization of educational policy and practice have generated a climate in which technology development broadly serves the needs of the population as a whole. This modus vivendi can be contrasted to that of Germany and the United States where digital divides and achievement gaps are more acute notwithstanding breakneck advancements in ICT diffusion.

62. See Manuel Castells and Pekka Himanen, *The Information Society and the Welfare State: The Finnish Model* (Oxford: Oxford University Press, 2002), 115.
63. *A Great Migration,* 35 (figure 3.16).
64. Nordic Council of Ministers, *Nordic Information Society Statistics 2002* (Helsinki: Statistics Finland, 2002), §2.2. Available at http://stat.fi/tk/yr/tietoyhteiskunta/nordic_iss_02.pdf.
65. *A Great Migration,* §3.3.
66. *Knowledge and Skills for Life,* 58, 60, 308.

4. POLICY IMPLICATIONS

I will briefly discuss four broad policy implications following from the discussion of national ICT and education policymaking in the United States, Germany and Finland. They can be summarized as follows:

- The vital importance of public and private sector leadership in developing and realizing ICT objectives, with an eye toward broad stakeholder involvement and a long-term vision for inclusion and excellence.
- A focus on comprehensive and holistic approaches to ICT integration. Too much fragmentation and superficiality of policies and programs leads to inefficiency and benign neglect of the underlying causes of marginalization.
- The importance of dependable and equitable funding streams to sustain and scale national initiatives.
- Human-capital development as the driver to raise performance and productivity for civic and economic inclusion.

In the late 1990s OECD countries developed e-learning action plans, strongly supported by public- and private-sector leaders, to usher in the information society. This period's economic expansion allowed for unprecedented investments in infrastructure, digital content and personnel training so that demonstrable productivity and learning gains began to occur. These huge sunken investments today have yielded a widespread digital infrastructure in many OECD countries, with broadband diffusion the new technological hurdle to cross vis-à-vis ICT equity. This first-wave of deep ICT investments represents the end of the beginning, not the beginning of the end, both in renewing teaching and learning and in realizing significant efficiency and productivity gains from the tools. Indeed, the journey toward an equitable, high-performing learning society in the information age is in its early stages. Standards for integrating digital literacy skills into most learning institutions' curriculum and assessments have yet to be formed let alone adopted—and teacher certification and professional support downplay techno-pedagogical innovation. Hence the need for robust leadership and vision lest the sunken investments contributing to closing the digital divide and the achievement gap wither on the vine.

In the United States several organizations and committees including the CEO Forum on Education and Technology, a unique five-year partnership between business and education leaders, and the President's Information Technology Advisory Committee (PITAC), a panel of research, academic and industry experts, offered recommendations on ways to unfurl the information society. Substantial expansion of equity provisions, professional development and R&D were strongly endorsed under the mantle of a long-term investment strategy increasing educational technology funding as a proportion of the total education budget to five percent.[67] A new public-private coalition in the United States, the Partnership for 21st Century Skills, released a report establishing a common nomenclature and a readiness guide so schools can gauge their capacity to renew their teaching and learning using ICTs. In the coming months and years, the Partnership will deepen its work to influence the development of curriculum and assessments as these tools truly become basic to learning in the twenty-first century.[68]

Action plans help to coordinate and steer national policy, since the information society agenda cuts across many functional arenas. In the United States almost every cabinet department has initiated e-

67. CEO Forum on Education & Technology, *Education Technology Must Be Included in Comprehensive Education Legislation: A Policy Paper* (Washington, DC: CEO Forum, 2001), 7-8. The report notes educational technology funding was less than two percent of total K-12 spending in 1999-2000. Available at http://www.ceoforum.org/downloads/forum3.pdf.
68. See www.21stcenturyskills.org.

developments; yet the sum total of these efforts are largely uncoordinated and offer weak links to the shrinking number of private-sector initiatives. The striking example from the United States is the E-rate, a program providing benefits to schools and libraries yet existing apart from the departments and agencies responsible for steering education and library policymaking. Without embedding technology into comprehensive, coordinated solutions to meet young people's real needs (with a strong role for research and evaluation), many benefits will remain rarefied.

With various ministries and departments motivated by different goals and accountability structures taking divergent approaches to an information society agenda, clearly there are gaps and redundancies in composing comprehensive solutions for underserved youths. Piecemeal approaches to content development, training, R&D and infrastructure coverage will hinder countries in reaching their information society goals. According to the President's Information Technology Advisory Committee, "education and learning R&D are dramatically underfunded," consisting of less than 0.1 percent of the total federal education budget.[69] PITAC recommended increasing this proportion to no less than 0.5 percent or approximately U.S. $1.5 billion in order to fund innovation in educational applications, such as virtual or mobile learning, digital content and learning models customized to the needs of disadvantaged communities, such as the learning disabled and immigrants.[70] This R&D, including rigorous evaluation of program effectiveness, should direct a country's strategic policy interventions, particularly on behalf of disadvantaged subgroups, to transcend the one-size-fits-all solutions often pervading a national policy agenda.

Clearly developing human capital is the hallmark of an information society, including embarking on a process in which continuous learning opportunities are culturally acceptable and readily available. Beginning with teachers, infrequent opportunities exist to learn new skills in new environments. The CEO Forum recommended that the U.S. federal government should apply at least 30 percent of federal education technology funding to durable and intensive high-quality professional development by 2003; the actual investment today is far afield of this figure.[71] Realizing an inclusive learning society in this climate is an uphill climb. A culture of learning is also attenuated. American adolescents spend upwards of seven hours a day outside of school consuming media, mostly watching television and listening to music. And the videogame craze has eclipsed Hollywood as a global commercial venture with uncertain effects on children and adolescents. Migrating young people's affinity to ICTs into more active and collaborative *educational* purposes will be a formidable challenge—and a ripe arena for R&D and potential policy intervention—in the years ahead.[72]

In the realm of ICTs and equity, there is considerable room for stakeholder engagement. In fact citizens will unlikely get the media environment receptive to the educational and social needs of young people on society's margins without raising their voice to be heard. The guideposts for the information society are still being established, and citizen engagement is essential, as well as strong leadership from governments, industry and civil society. The message must be sent by concerned citizens—and well received by elected representatives—that the information society is for everyone, not just rhetorically but in concrete, sustained action in pursuit of its actualization. At a time when inequalities are growing in many OECD countries, ICTs offer the potential to close achievement gaps and provide manifold opportunities for disadvantaged youths to enter the mainstream. But this will not happen without concerted attention and collective action toward creative solutions and bold new initiatives.

69. President's Information Technology Advisory Committee, *Using Information Technology to Transform the Way We Learn* (Arlington, VA: National Coordination Office for Information Technology Research and Development, 2001), 14. Available at http://www.hpcc.gov/pubs/pitac/pitac-tl-9feb01.pdf.
70. For an exploration of the types of initiatives increased R&D dollars should be geared toward in the e-learning arena, see Thomas A. Kalil, "An Information Commons for E-Learning: Designing a Digital Opportunity Investment Trust" (Washington, DC: New America Foundation, 2002). Available at http://www.newamerica.net/Download_Docs/pdfs/Pub_File_848_1.pdf.
71. CEO Forum, *Policy Paper,* 9.
72. Anthony G. Wilhelm, "Wire-less Youth," *National Civic Review* 91:3 (2002), 29

ACKNOWLEDGEMENTS:

The author would like to thank the following individuals for their advice and assistance in preparing this paper: Arthur Sheekey, the CNA Corporation; Herbert Kubicek and Andreas Breiter, University of Bremen; Jutta Croll, Digital Chances Foundation; Lea Parjo, Statistics Finland; and Jouni Kangasniemi and Ritva-Sini Merilampi, both from the Finnish Ministry of Education. Of course any errors or omissions are the sole responsibility of the author.

CONSCIOUS ICT POLICY AS A STRATEGY TO PROMOTE EQUITY IN SCHOOL

A CASE STUDY FROM FINLAND

Liisa Ilomäki, Minna Lakkala and Kai Hakkarainen

Department of Psychology University of Helsinki

INTRODUCTION

The aim of this article is to discuss questions of equity in relation to ICT, the role of schools in fostering it, and how schools can support equity, in particular by conscious solutions in ICT usage. We describe one example, a school in which the usage of ICT began rather early and which has had a strong commitment to pedagogical development of ICT, and discuss the characteristics of this school's ICT reform that have possibly advanced equity between genders, students with differences in academic skills, and those of differing socioeconomic status. The article is based on longitudinal case studies in Länsimäki School (Ilomäki, Syri & Lehtinen, 2001, Ilomäki & Rantanen, 2003, Ilomäki, Lakkala & Lehtinen, 2003). The original research focus in these studies was not on questions of equity but the data and findings of the studies provide a basis to form conclusions about some questions related in ICT and equity. The detailed description of the data collection and analysis is presented in the articles mentioned above.

The focus of the present paper is on ordinary activities of the school; activities of special emotional, psychological and intellectual support of particularly 'needy' students are left out from the article, although they are also essential means to diminish inequity.

Finland is regarded as an advanced information society with extensive technological infrastructure. The administrative structures support the policy of extending the information society to all people, and this societal development is widely endorsed by the citizens. The goal in the Finnish National Strategy for Education, Training and Research in the Information Society (Ministry of Education, 1999) is that "*by the year 2004 Finland will be one of the leading knowledge and interaction societies. Success will be based on citizens' equal opportunities to study and develop their own knowledge and extensively utilise information resources and educational services. A high-quality, ethically and economically sustainable mode of operation in network-based teaching and research will have been established.*"

In some aspects, practice has begun to come closer to these aims. Computers and Internet are widely used, by both genders and by all age groups, excluding the oldest ones. For example, the three most used Internet services, independent of age group, were personal email contacts, information search and free services, and surfing in the net (Nurmela & Ylitalo, 2003). There is every reason to argue that within the space of five years, there has been a great shift of Finnish people into the information society, measured in terms of the increasing use of mobile phones, PCs, the Internet and e-mail (Nurmela, Parjo and Ylitalo, 2003). Although the information society seems to be adopted by citizens, there remains an intriguing question about the Finnish information society: how do its commitments concerning equity and equitable outcomes become fulfilled for various groups, based on age, gender or social background?

THE USE OF ICT IN VARIOUS AGE AND SOCIAL GROUPS

According to Nurmela & Ylitalo (2003), there are some interesting differences between age groups. In Finland, as in many other countries, the households with school-aged children have more computer and Internet-connections than others. In 2002, 86 % of the age group10—14 had a possibility to use computer at home and 71 % had an Internet-connection, but only 76 % of the age group 15—19 had a possibility to use computer at home and only 58 % had an Internet-connection. The possibility to use computer at home was 63 % and Internet-connection 58 % in all age groups between 10—93. It was also interesting that differences based on region were smallest among 10— 29 years old, e.g., the highest precentage, 93 %, of the age group used PC at capital area, and the lowest percentage, 83 %, at the sparsely populated rural area. (Nurmela & Ylitalo, 2003). The national educational policy treats ICT as essential in schools. In education, two national information strategies have been accepted and carried out since 1996. (Ministry of Education, 1995, 1999.) The latter Information strategy for education and research regards media literacy as an essential part of all-round education; media literacy is defined as skills to utilize both the traditional and the new media as well as ICT in daily life for knowledge searching and construction, communication and self-expression. In the strategy, girls and women are regarded as a special group for who need supporting projects. In the Implementation plan of the Information Strategy for education and research 2000—2004 (Ministry of Education, 2000), the attention is focused on the needs of groups outside the education system: the middle-aged and older population, the adult population not actively employed and special-needs groups. Similarly, in a national program which concentrates on preventing poverty and social drop out, the uneducated adult population was regarded as a group that needs support to gain the skills of information society, and which might drop out even more, because of the increasing and changing demands of competence in the information society (Ministry of social affairs and health, 2003). The assumption in the implementation plan was that pupils, students and working adult population have good possibilities to reach the necessary skills of information society in schools and in work; there is no need to focus on these groups on a national level. Based on these national outlines, the authorities appear unconcerned about the possible drop of ICT competence of children or teenagers in schools; the only exception is the remark about girls (and women). There is an implicit assumption that children and students acquire the necessary skills at home and at school.

However, the gap between students is not only in technological resources but in intellectual resources; in other words: how parents guide the use of ICT, how aware they are about what students do with the computer, and how well they can help their children to enlarge the use of ICT. In a sur-

vey about parents thoughts about ICT in education (Koivisto, Syri, Ilomäki, Tapola, Hakkarainen, Lakkala, 2001), we found out that children of higher educated parents with higher professional status used computers more at home than children of lower status parents. The more highly educated and more ICT-using parents were realistic about the use of ICT: they didn't have special fears of technology, nor unrealistic expectations. The parents with less knowledge about ICT, less experience with computers and with lower academic status were more critical about the use of ICT in education, but they also expected more service and instruction from school concerning ICT usage.

GIRLS, BOYS AND TECHNOLOGY

Many studies have shown that boys find computers more attractive, and feel more positively towards computer use than girls. There is also evidence that boys feel more competent with ICT (Hakkarainen, Ilomäki, Lipponen, Muukkonen, Rahikainen & Tuominen, 2000; Ilomäki, Hakkarainen, Lakkala, Rahikainen, Lipponen & Lehtinen, 2002). As Clegg (2001) has shown with several examples, technology and computing still have a connection with male culture. The items of 'know how' – knowledge and skills – of the culture of technology constitute a set of socially constituted practices, embedded with a common set of attitudes, preferences and likings; these are generally more congenial to, and favor, boys and men compared to girls and women. It might be expected that boys and men just continue to participate in "the male ICT" while girls and women have to overcome a barrier before they can make use of ICT. On the other hand, the technology has become more user-friendly than before, and it is not necessary to know the technical side of computing, to use applications.

Boys tend to develop a special kind of "adaptive expertise" in ICT. This expertise is closely combined with the technical features of ICT. In a study of students' ICT expertise in Länsimäki school – the same school, which will be presented as the case study school in this article— it was found that during an intensive use of technology, based on personal use of laptops, both boys and girls developed a good competence of ICT. Characteristic for all students in the experiment class was the concept of the computer as a tool, as well as for learning in school and in leisure time. However, a group of three students constructed high-level adaptive expertise in ICT, which consisted of such features as a motivation to develop even professional skills in ICT and a wide and conscious meta-understanding about own competence (Ilomäki & Rantanen, 2003). Similar results for expert-like male teen-agers were reported in another Finnish study of students' ICT competence; about 10 % of the participants had this kind of special ICT expertise, and they all were boys (Hakkarainen et al., 2000).

ICT AND GENDERS AT SCHOOL

Schools have an important role in supporting girls to use ICT because schools can give an equal opportunity for the genders to learn and use ICT connected to learning processes (see e.g., Krapp & Lewalter, 2001). Equal opportunity and equal access are by themselves probably insufficient to bring about equitable outcomes in several important cases; that is the rationale for special attempts to motivate girls, e.g., through girls' computer clubs. Further the social support structure (see below) must be such are to encourage all groups to participate. Because the gender difference in relation to new technology appears to increase as a function of age of the students, being less remarkable at pre-

school age, it may be at least partially produced within the early school years (Crook, 1996) and within those classrooms. Observations of students working with computers show that mixed gender pairs perform less well than single-gender pairs (Underwood et al., 2000; Fitzpatrick & Hardman, 2000). This may be partially because a male student often tends to dominate situations in which he is using a computer jointly with a female student. The results are not, however, entirely consistent. There is some evidence that new pedagogical methods, such as cross-age tutoring and peer tutoring, may facilitate the development of female students' computer skills (Bromfield et al., 2001).

Novel pedagogical practices and social support may facilitate gender inclusive experiences where females and males are participating and performing equally (Mayer-Smith et al., 2000). Although male students are interested in using ICT regardless of the nature of the application, the nature of the application and related activities tend substantially to affect female students' interest (Littleton & Bannert, 1999; Brunner et al., 2000). A significant finding is that young girls are very interested in interactive technology that encourages collaborative learning, solving of complex social dilemmas, intensive writing, and flexible pursuit of problem solving (Littleton & Bannert, 1999). Research on computer-supported learning indicates that female students are more willing to share their cognitive achievements and are more interested in collaborative learning than male students (Underwood et al., 2000; Hakkarainen, 1998).

Bielaczyc (2001) has provided evidence that the key to successful implementation of computer supported collaborative learning – especially to female students' equitable participation in computer-supported learning – is to build a supporting social infrastructure around the technical infrastructure. She argued that instead of focusing only on the collaborative technology, one should examine social settings that support the meaningful implementation and use of technology. The notion of social infrastructure implies that new technology should be an integrated aspect of pedagogical processes rather than a separate activity.

THE CASE OF LÄNSIMÄKI SCHOOL

Länsimäki School started to develop the use of ICT with a Laptop project together with the City of Vantaa and the University of Helsinki in 1994. The results of the project were encouraging, and the collaboration between the researchers and the school was good. Therefore, the collaboration with the school and the research team continued in the EU-funded CL-Net project in 1998—2000. When the OECD Study started in 2000, Länsimäki School had so many good practices and results of using technology that it was chosen for a research school for that study. In consideration of the school's interest and motivation, good results in applying ICT, and good collaboration with researcher(s), Länsimäki School formed an ideal case for a longitudinal instrumental case study (Stake, 2000) .

Context of the studies

Länsimäki School is a lower secondary school located in an eastern suburb of the city of Vantaa. The socio-economic status in Länsimäki area is somewhat lower than elsewhere in Vantaa; for instance, the percentage of immigrants is 9.0%, which is high compared with the mean, 3.9 %. In 2001, Länsimäki School had 381 students; 209 (54.9 %) of them were girls, 172 (45.1 %) were boys.

Compared with Finnish schools, Länsimäki School had more immigrant students, 46 (12.1 %)(1.5.2000). Länsimäki School is a typical suburban school because the students come mainly from the two closest elementary schools, and many of the students continue to a local higher secondary school. In 2001, the staff consisted of 50 teachers or other employees working in education. The mean number of teaching hours per week per teacher was about 22. The principal emphasized ICT skills and willingness to participate in professional development processes when choosing new teachers. The size of classes was rather small, about 20 students per class. The school building was 10 years old and in good condition. The classrooms were fully booked, but there was not any lack of space.

In 2001, Länsimäki School had two classrooms and a library/info centre equipped with modern computers and network connections for student use. There was also one classroom with an old computer used to learn typing. In addition, about 20 computers with Internet access were located in classrooms. A few computers (5—7) were exclusively for teacher use. In all, the school had, on average, 7—8 students per a computer, which was about the same number as the National Board of Education has been aiming for (8). The school had one digital camera and "enough" printers and scanners. All students had a username for the school network, so all use could be identified afterwards. Although resources were quite good, ICT was used so extensively that there was a need for more computers. Technical support for ICT was organized in a way typical of Finnish schools: the ICT teacher took care of all the technical work, and she got a 2—3 hours' payment for this per week. The technical experts of City of Vantaa helped in some special cases.

In the interviews conducted in 2001, parents, teachers and students described Länsimäki School in similar ways. The characteristic features, summarized from the interviews, were the following:

- Emphasis on students' complete social welfare, not only academic performance. The school tries to take care of students in special education, immigrant students, and students with learning difficulties.
- Emphasis on school as an entity: There is a conscious aim to develop a common feeling of "our school" and a good social atmosphere. Parents are also involved, although this connection does not reach all parents.
- Emphasis on school development and being up-to date. This is especially seen in the use of ICT, which is regarded as an essential and necessary element of the school. The use of ICT is also a question of image. Länsimäki School is appreciated in Vantaa for its applications of ICT in particular.

HISTORY OF THE ICT RELATED REFORMS IN LÄNSIMÄKI SCHOOL

Laptop project 1994—1997

The students of a 7th grade class had laptops for their personal use throughout the three years of lower secondary school. With this project, the teachers taking the initiative wanted to start a reform in the use and development of ICT in education. Länsimäki School was, in Finland, among the early adopters of ICT.

In the beginning of the project, the staff members of the IC Learning Centre (a university unit), and two teachers of Länsimäki School formed the idea and the structure of the project. The project

was organized collaboratively with the school, the university unit, and the City of Vantaa school administration. The university unit supported the project by consulting, training teachers and doing research. The City of Vantaa provided the laptops and funded the teacher training.

Participation was voluntary for both the students and the teachers. The participating teachers had technical and pedagogical training and consultation. The consultation was organized both for groups and for individual teachers. In the beginning of the process, in the autumn 1994, the goals of the consultancy were 1) to develop the learning environment to emphasize the students' independent activity in learning tasks, collaboration and support for process learning, metacognition and authentic learning activities ; 2) to develop individual teacher's pedagogical and ICT skills; and to 3) to support the participating teachers in forming a reflective learning community.

The pedagogical and the technical development were in quite good balance, and from the very beginning, the pedagogically meaningful use of ICT was emphasized. For this reason there was no pedagogical resistance to ICT among the teachers.

After the Laptop project, Länsimäki School carried out practical reforms for the pedagogical use of ICT. The library was renovated into a media centre with books and information technology resources. All 7th grade students had some obligatory ICT-training, which was integrated into other subjects, such as learning to use word processors. These courses were carried out with the ICT teacher and the content teachers.

CL-Net-project 1998—2000

In 1998, the school joined in an EU-funded CL-Net-project, a computer-supported collaborative learning research project (Van der Meijden, Simons, & De Jong, 2000). In the project, the teachers in Länsimäki School investigated the development of innovative new learning environments in collaboration with the Universities of Helsinki and Turku. The pedagogical principles of the project were imported by the university researchers, and the aim was to develop learning in the form of collaborative knowledge building and progressive inquiry (Bereiter & Scardamalia, 1993; Hakkarainen, 2003). The concrete learning projects were constructed, together, by the researchers and the participating teachers. This project started a new pedagogical development phase in Länsimäki School, first with 3—4 teachers. During the next year, five other teachers started to use a collaborative learning environment, WorkMates.

There were two groups of teachers who used the collaboration application: Science teachers had three projects based on inquiry learning. History teachers used the collaborative application more traditionally; it was used as a publishing and commenting forum for individual products.

Students' ICT skills and ICT usage

The level of students' ICT skills has been heterogeneous, based on the data collected for the different studies. The interviewed teachers in 2001 regarded the level of students' ICT skills as quite

high. Those teachers, whose own skills were limited, tended to overestimate students' ICT skills in particular; the technology specialist had a less optimistic opinion.

A survey of students' use of and skills in ICT was carried out in one 9th grade class in 2001 as a part of the OECD study (Ilomäki, Syri & Lehtinen, 2001), and it revealed deep differences between boys and girls. According to self evaluation, boys estimated that they knew well or really well both technical use of ICT (like file management or implementing accessories) and the use of many software applications: word processors, painting/drawing and the Internet. Girls estimated that they knew only the Internet well. All students reported that they didn't know desktop publishing, programming and www-publishing.

It is difficult to estimate how many students of Länsimäki School have a computer at home. The social background of the students is rather low, and households with less educated parents and low income have fewer computers. Our informed guess is that about 80 % of the students had a computer at home. An Internet connection was less common; e.g., the survey of the 9th grade class in 2001 showed that 7 students out of 16 who had a computer at home did not have an Internet connection at home.

Students used various ICT applications to a great extent during their leisure time, boys more so than girls. The interviewed students, in 2001, used e-mail and word processors and boys played games. The survey showed that 8 students out of 17 used ICT daily. All students used it at least sometimes. Those students who used it less than once a month were three girls, two of whom were immigrants. The time spent in ICT was mainly less than one hour per day.

Länsimäki School has developed, with two local elementary schools and an upper secondary school, a system of teaching ICT skills. The two elementary schools are responsible for basic skills. In Länsimäki school, all students in the 7th grade have an compulsory ICT course to fill possible gaps. Students learn to use various applications in some curriculum context (like word processing in writing stories and counting elements of receipts with spreadsheet applications). This course is carried out both with the ICT teacher and the subject teachers. The idea is to diminish the differences between students, between boys and girls and Finnish and immigrant students. The compulsory course started in 1999.

Achievements and consequences of the reforms in Länsimäki school

ICT applications in classroom

In 2001, the majority of teachers in Länsimäki School used ICT-supported activities at least somewhat in classroom lessons, and the activities seemed to be appreciated amongst the fellow teachers. Teachers in Länsimäki School obviously used ICT more than ordinary teachers in Finland. A study of teachers in Helsinki in 1999 showed that about 35 % of teachers used a computer at least once in a week for teaching; 23 % of teachers never used a computer (Ilomäki & Lakkala, 2003). The use of ICT had encouraged the interviewed teachers, and they thought that the use of ICT had diversified their teaching methods, radically changed their conceptions of learning and teaching, and motivated them in their work.

As described, the ICT skills of students have been sufficient for using computers at school, and the activities of the school to support the development of ICT skills and to diminish the possible gaps have made the use of ICT rather easy and accessible to most students in classrooms.

There were several ways that ICT was used:

1. ICT as a tool for writing, information search in WWW and for calculating. This was the main use of ICT. The most popular application in classroom was word processing. Because several teachers carried out learning projects based on writing, students were used to writing reports and articles. WWW-browsers were the next popular application. The use was mainly information search. Teachers used e-mail with students only seldom, but some teachers got e-mails from parents. A spreadsheet was seldom used with students. Some teachers had used some special tools like a graphical calculator, or a personal digital assistant in their classes.

2. Traditional computer assisted learning. Books, workbooks, teacher hints and computer programs formed integrated learning-material packages. Instructional programs had a stable user group: language teachers, and occasionally teachers of math, physics and chemistry.

3. ICT for collaboration and publishing. The wider pedagogical use of WWW appeared to be the next step in teaching and learning. WWW was quite new for the teachers, and not in regular use; only one third of the teachers used WWW applications in 2001. Teachers, who had participated in computer supported collaborative learning projects, reported that they had participated in on-line discussion forums, chat rooms and MUDs and in other virtual courses at least once a month. Three teachers had prepared material for virtual courses, which were open also to other schools. (This material production for WWW was an exceptional teacher activity, compared to teachers in Finland in general.)

4. ICT as a learning content. All 7th grade students had some basic knowledge about ICT, integrated into other learning contents. In the 8th and 9th grades, ICT was a voluntary subject with 2 hours/week.

ICT was mainly used collaboratively so that two or three students used one computer together. The solution to use computers in pairs was based both on pedagogical reasons and on the lack of computers.

Changes in pedagogical practices

In 2001, the student-centred approach in learning had become the leading approach in the school. Students were active, for example, in collecting, processing and constructing information. They had process- and project-oriented activities that directed their motivation to questions and problems that interested them. Students were themselves responsible for the learning process, which helped them to build up metacognitive skills.

In addition, several teachers especially used metacognitive tools, e.g., self-evaluation questionnaires or portfolio assessment. The teachers became conscious of the importance of pedagogical collaboration, and some started to aim for collaborative knowledge building as part of their teaching. Authenticity became important; phenomena outside the school became the subject of learning con-

tent. Authentic learning activities were usually constructed within different kinds of problem-based or inquiry learning applications.

For a school, it is a permanent challenge to teach well. Länsimäki School has been able to adopt some advanced teaching methods that are believed to promote meaningful learning. However, many of the school's daily practices have still reflected a rather traditional teacher-centered approach. In addition, new kinds of pedagogical problems arose because the new, more advanced teaching practices also have their problems. Project-based learning, which was widely used in Länsimäki, is only seldom organized around a problem (Jonassen, 1999) or the problem is constructed unwittingly, so that it does not support the integration of activity and the knowledge behind it. Learning becomes doing instead of doing with understanding (Barron et al., 2001). Such projects could also be found in Länsimäki. Another problem caused by the new technology was the use of the Internet in information search. The search methods were often ineffective, and the pedagogical results of the projects were modest.

DISCUSSION: SOLUTIONS AND DECISIONS IN LÄNSIMÄKI SCHOOL THAT SUPPORT EQUITY

Conscious policy

At Länsimäki School, we found some evidence that the conscious decisions and solutions have possibly helped to diminish the gap between different groups of students as users of ICT. The solution to teach all students basic skills of ICT is one of such practices, as well as the solution to use ICT widely integrated into learning processes. As the principal pointed out, "equity is constructed by giving all students the possibility to learn to use ICT, and thus diminish the gap between poor and rich students, which easily culminated by ICT." ICT related learning activites are based on the ICT resources at school, not at home, and the school created an open working place for students (media centre with computers, Internet connections and traditional library). It might again be mentioned that simple provision of 'opportunity' possibility or access is not sufficient to reach the students of certain groups for whom motivation and interest are problematic. In the case of girls, the school had begun to deal with the problem. Some cases of immigrants remained problematic.

The gap in academic performance is more difficult to avoid or diminish. There exist differences in academic performance, in school motivation, and so on, and these differences are dependent on socioeconomic background, the parents' own education and profession. At Länsimäki School the solution was to attempt to prevent social problems and thus make "normal" school possible. This certainly helped some students to concentrate (also) on academic performance.

The use of ICT has motivated some students, especially boys, and this has helped these students perform well at least in some activities which might have supported their school performance as a whole.

Pedagogical practices

Different kinds of process work methods, which were largely in use in the school, support a student's independent and responsible learning. Students have more ownership of the tasks. These motivate the majority of learners, and such methods also support metacognition and an inner moti-

vation. Students work for themselves, not (only) for the teacher. Because students in many learning processes had opportunities to concentrate on topics that interested them, the activities did not favour boys more than girls, although they were used to ICT. For example, when studying statistical mathematics, several pairs of girls related their own research in family affairs *("how well a family with twin babies manages financially").*

On the other hand, students were also taught in a way that might expand the gap in academic performance. Open and demanding learning activities create inner motivation and ownership, but only when there exists situated and specific tutoring. Access to the Internet as an information resource doesn't support students with fewer metacognitive skills. A similar popular activity was "project work"; such efforts sometimes turned out to be mere collections of "copy and paste" activities rather than productions of processed knowledge. A third example of activities that might expand the gap was working in pairs. The more advanced / "the stronger" of the pair takes the responsibility, and the other one cannot participate, and therefore does not get an opportunity to learn, as well.

In Länsimäki School, equity of genders has not been reported as a problem – it has never come up in interviews or other discussion. Maybe there were not such gender differences of skills, which had been noticed when doing various learning activities. These were perhaps avoided by the intensive use of ICT; all students used ICT and had the necessary basic skills. The possible differences of competence were not essential during the learning activities. Another, interesting explanation for the possible gender equity was the ICT-teacher: she was active, appreciated and had a strong influence in the ICT policy of the school. Although she didn't have any special support for girls, she might have been a good role model and showed that women, and girls, can also be ICT professionals.

REFERENCES

BARRON, B., SCHWARTZ, D., VYE, N., MOORE, A., PETROSINO, A., ZECH, L., ET AL. (2001). Doing With Understanding: Lessons From Research on Problem- and Project-Based Learning. *The Journal of The Learning Sciences, 7*, 271-311.

BIELACZYC, K. (2001). Designing Social Infrastructure: The Challenge of Building Computer-Supported Learning Communities. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *European Perspectives on Computer-Supported Collaborative Learning. Proceedings of the First European Conference on CSCL* (pp. 106-114). McLuhan Institute: University of Maastricht.

BROMFIELD, L. M., CLARKE, V. A., & LYNCH, N. (2001). Comparing alternate teaching styles to teach computing skills to girls in their English classes. *Computers & Education 36*, 285-297.

BRUNNER, C., BENNETT, D.T., & HONEY, M. (2000).
Girl games and technological desire. In *The Jossey-Bass Reader on Technology and Learning* (pp. 168-183). Wiley, San Francisco.

CLEGG, S. (2001).
Theorising the Machine: gender, education and computing. *Gender and Education, 13*, 307-324.

CROOK, C. (1996).
Computers and the collaborative experience of learning. London: Routledge, London.

FITZPATRICK, H., & HARDMAN, M. (2000).
Mediated activity in the primary classroom: girls, boys and computers. *Learning and Instruction 10*, 431-446.

HAKKARAINEN, K. (1998).
Epistemology of inquiry and computer-supported collaborative Learning. Unpublished doctoral dissertation, University of Toronto.

HAKKARAINEN, K., ILOMÄKI, L., LIPPONEN, L., MUUKKONEN, H., RAHIKAINEN, M., TUOMINEN, T., ET AL. (2000).
Students' skills and practices of using ICT: Results of a national assessment in Finland. *Computers and Education, 34*(2), 103-117.

ILOMÄKI, L., SYRI, J., & LEHTINEN, E. (2001).
A Finnish pilot study in OECD evaluation: Scaling up innovative ICT practices – a case study of Länsimäki school. Retrieved 05.12, 2003from
http://www.oecd.org/pdf/M00024000/M00024185.pdf

ILOMÄKI, L., HAKKARAINEN, K., LAKKALA, M., RAHIKAINEN, M., LIPPONEN, L., AND LEHTINEN, E. (2002).
Uses of New Technology Across Genders and Generations: Comparing the Development of Students' And Teachers' ICT Skills and Practices of Using ICT. In *Proceedings of Second International Conference on Technology in Teaching and Learning in Higher Education* (pp. 539 – 548). Athens: National and Kapodistrian University of Athens.

ILOMÄKI, L. & RANTANEN, P. (2003).
Intensive use of information and communication technology (ICT) in lower secondary school: Development of student expertise. Manuscript resubmitted for publication.

ILOMÄKI, L., LAKKALA, M., & LEHTINEN, E. (2003).
A *case study about ICT adoption within a teacher community at a Finnish lower secondary school.* Manuscript submitted for publication.

JONASSEN, D. (1999).
Activity Theory as a Framework for Designing Constructivistic Learning Environments. *Educational Technology Research and Development, 47*, 61-79.

KOIVISTO, J., SYRI, J., ILOMÄKI, L., TAPOLA, A., HAKKARAINEN, K., LAKKALA, M., ET. AL. (2001). *Vanhempien käsityksiä lastensa tieto- ja viestintätekniikan koulukäytöstä.* "Parents' thoughts about the ICT use in education". Helsingin kaupungin opetusviraston julkaisuja A1:2001. Available from City of Helsinki, Educational Department, Media Centre Web site, http://www.media.edu.hel.fi

KRAPP, A., & LEWALTER, D. (2001).
Development of interests and interest-based motivational orientations: A longitudinal study in vocational school and work settings. In S. Volet & S. Järvelä (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications*. London: Pergamon / Elsevier. (pp. 209-232)

LITTLETON, K., & BANNERT, M. (1999).
Gender and IT: Contextualizing differences. In J. Bliss, R. Säljö, & P. Light (Eds.), *Learning sites: Social and technical resources for learning*. Amsterdam: Pergamon. (pp. 171-182)

MAYER-SMITH, J., PEDRETTI, E., & WOODROW, J. (2000).
Closing the gender gap in technology enriched science education: a case study. *Computers & Education 35*, 51-63.

MINISTRY OF EDUCATION. (1999).
Education, Training and Research in the Information Society. National strategy for 2000-2004. Available from the Finnish Ministry of Education Web site,
http://www.minedu.fi/minedu/publications/online.html

MINISTRY OF EDUCATION. (2000).
Information strategy for Education and Research 2000-2004. Implementation plan. Available from the Finnish Ministry of Education Web site,
http://www.minedu.fi/minedu/publications/online.html

MINISTRY OF SOCIAL AFFAIRS AND HEALTH. (2003).
The national plan against poverty and social drop out for years 2003—2005. (In Finnish.) Sosiaali- ja terveysministeriön työryhmämuistioita 2003:23. Retrieved September 12, 2003, from http://www.vn.fi/stm/suomi/tao/julkaisut/koyhnappi/tr03_23.pdf

NURMELA, J., PARJO. L., & YLITALO, M. (2003).
A great migration to the information society. Patterns of ICT diffusion in Finland in 1996-2002. Reviews 2003/1. Helsinki: StatFin.

UNDERWOOD, J., UNDERWOOD, G., & WOOD, D. (2000).
When does gender matter? Interactions during computer-based problem solving. *Learning and Instruction 10*, 447-462.

ICT POLICIES ADOPTED FOR LOW ACHIEVING STUDENTS IN THE REPUBLIC OF KOREA

Myung-Sook Jeannie PANG

Korea Education & Research Information Service

DEFINITION OF LOW ACHIEVING STUDENTS

Ministry of Education in Korea defines low achieving students as those who are at normal range in IQ but did not reach the minimum standards in either 3R's(reading, writing, and arithmetic) or subject matter at grades of 1 to 10 (Ministry of Education, 1997).

POLICIES AND PROGRAMS THAT SUPPORT LOW ACHIEVING STUDENTS WITH ICT

Korea has implemented two major policies that support low achieving students and they are "Low Achieving Students Support Master Plan" and "Basic Skill Assurance Program". "Low Achieving Students Support Master Plan" was set up in 1997 to help low achieving students reach minimum standards for their better quality of life. "Basic Skill Assurance Program" which has been revised every year since 1998 was to design particularly to raise credibility on public education as well as to provide remedial courses for low achieving students. The common objectives of the two polices are to ensure every student to attain at least basic skills required by knowledge-based society upon high school graduation. To reach the objective primarily two programs are initiated at national level.

Development of national minimum academic standards and administration of a national test tool

The concept of national minimum academic standards was introduced in 1997 to the 7th National Curriculum for elementary and secondary school education emphasizing 3R's and subject minimum standards. The standards are applied to national standardized test tool that was administered in October 2002 to 3rd grade students nationwide.

Upon the test result low achieving students are identified and they are provided with remedial programs. Class teachers can cooperate to form a special class for low achieving students to provide remedial programs either after class or during school vacation. At secondary school level, class teachers are recommended to moderate the number of learning units as well as achievement level for low achieving students.

Teachers can adopt ICT equipments provided in every class and national online materials for free of charge. Those who practice good remedial programs are recognized. Teaching & Learning Center (http://classroom.kice.re.kr) provides comprehensive information on the 7th national curriculum, individualized learning, minimum academic standards, teaching guidelines for low achieving students, remedial program materials, assessment items, and good practices of model schools. Research and development on Computerized Test and Computer Adaptive Test (CT & CAT)is ongoing since 1998 as well.

Online multimedia education content through EDUNET

The concepts of cyber education, online learning, and e-learning were brought into formal education as the Education Informatization Affirmative Master Plan I was set up in 1996. As the master plan was implemented national online multimedia educational information system EDUNET (www.edunet.net) were developed which is currently served as cyber education hub in Korea. Any one can access to EDUNET to adopt online multimedia content including individualized learning materials especially designed for remedial education at either home or school. Multimedia content is developed in forms of online teaching-learning SW, clip arts, animation, sounds, images, etc. for 10 common subjects of 10 grades based on 7th National Curriculum. Thus online curriculum materials are served for regular courses as well as remedial courses.

Korea is presently implementing "Adapting ICT into Education Master Plan 2001-2005". One of major programs out of the plan that aids individual learners including low achieving students is 'Cyber Teacher' online service. The service is comprised of three channels and they are 'Subject Advice', 'Help Learning', and 'Q&A DB'. Those who serve as cyber teacher of the channel are elementary and secondary schoolteachers recommended by local governments. 'Subject Advice' channel covers subjects of Korean, math, sociology, science, and English at elementary and middle school education level. For high school education, subjects covered by 'Subject Advice' are biology, physics, physical geography, ethics, geography, history, computer, agriculture/life science, information industry, industry, etc.

The above mentioned online teaching and learning can be delivered in every class nationwide and including remedial program class. Such ICT environment was equipped as of April 2001 with the strong commitment of MOE&HRD. As of 2002, 60.4% of schools are networked to 2Mbps. By 2007 every school library is going to be networked thus online search on remedial program materials including teaching strategies can be better accessed. It is also expected that students are facilitated with more diverse reading and learning materials.

Ministry of Information and Communication is planning to make ICT available at 50,000 households of economically disadvantaged students nationwide providing a PC and fees for the Internet

usage and ICT training by 2005. Completion of the project will aid narrowing down digital divide among low achieving students as they tend to come from economically disadvantaged households.

STAKEHOLDERS

The main stakeholders involved in the policy design, implementation and evaluation are composed of four groups, central/local governments, schools, agencies, and industries. The functions are as follows.

Government

There are two central administrative bodies and they are Ministry of Education and Human Resources Development (MOE&HRD) and Ministry of Information and Communication (MIC). As MIC administers informatization project at national scheme, MOE&HRD works together with MIC, especially on the Internet access of schools and communities.

In relation with ICT the roles of MOE&HRD is to set up of national level of policies, provide sustainable finance, develop standardized national test tool, develop teaching models and materials, develop and disseminate materials through EDUNET (www.edunet.net) and Teaching & Learning Center (http://classroom.kice.re.kr), and assess the status of local governments' implementation.

To conform with central government's policy, local governments of 16 Municipal and Provincial Officies of Education set up action plans, provide sustainable finance, support in-service teacher training, adopt national standardized test tool to schools, develop teaching guidelines/training programs, disseminate teaching strategies resulted from model schools and research via EDUNET and Teaching & Learning Center.

Schools

Schools run Teaching & Learning Support Center at their own school site to research and develop diverse teaching methods and materials. Schools run remedial classes after class and/or during school vacation under responsibility of class teacher at elementary schools and subject teacher at secondary schools. Such remedial classes are formulated based on standardized national test.

Agencies

Agencies that are primarily involved in low achieving students education with ICT are KERIS (Korea Education & Research Information Service) and KICE (Korea Institute of Curriculum and Evaluation). KERIS runs EDUNET that provides online multimedia data and teaching-learning practices that help low achieving students with individual learning activities. KICE is responsible for running Teaching & Learning Center that primarily privides academic standards, national test tool, teaching strategies and dissemination of good practices. The agencies work with university faculties, schoolteachers, industries to get expertise and promote the outcomes.

Industries

In the process of developing materials and provision of ICT infrastructure to schools, textbook publishers, telecom/network company, HW/SW(on/off-line) vendors, etc. are closely involved.

POLICY IMPLEMENTATION

In order to support the provision of remedial courses for low achieving students the following enactments were formulated.

Elementary and Secondary Education Law, #6714

revised on January 29, 2001

- *Article 9*: MOEHRD can evaluate students at schooling in order to measure their level of achievements.
- *Article 28*: The central and local governments should implement necessary policies such as flexible curriculum management including number of school days for students either who did not meet the minimum standards or who could not continue schooling due to abnormal character.

Human Resources Development Law, #6713

revised on August 26, 2002

- The purpose of this law is to effectively develop human resources in order to improve quality of people's life and national competitiveness.

Copyright Law, #6134

revised on January 12, 2001

- For the purpose of elementary and secondary school education, copyrighted materials publicized can be inserted in textbooks and copied/utilized within class of formal school education without getting permission.

RESOURCES REQUIRED

In the process of implementing policies central government's strong leadership along with sustainable finance are utmost important. Under the strong leadership the financial resources have been rendered for developing/operating online education service system, provision of PCs and Internet networking, R&D in teaching methods, in-service teacher training, and on/off-line support programs including counselling.

EDUCATIONAL OUTCOMES

In relation to research on educational effectiveness on the ICT use for low achieving students Korea is at starting stage. The first national standardized test tool that identifies low achieving students was administered in October 2002, thus discussion on the outcomes is not ready yet. However the expectations from the initiative are as follows based on the reports of model schools supported by local governments.

- National systematic approaches such as a setup of standardized national test tool and on/off-line teaching-learning materials for low achieving students are expected to reduce teachers' burden in class preparation, enhance their professional competencies, reduce overlapped investments, and collective preparation on current issues.
- Online materials via EDUNET and Teaching & Learning Center are free from physical damages and usage fees. These features are critical when it comes to repeated usages.
- School homepages take the role of communication channels among teachers, parents, students, and the communities for better understanding toward low achieving students.
- Use of diverse multimedia data via the Internet, PC, and projectors in teaching-learning process help students understood clearer.

Although educational outcomes on low achieving students with ICT support at central government level is not yet ready due to its early stage, there were several attempts made at local government level to see the evidence on its effectiveness. The followings were some of the findings.

- Students' self-esteem, learning attitude, collaboration with peer groups seemed to be enhanced. (Jeju Sam-sung Girls' High School, 2001)
- Diverse materials in teaching and learning seemed to help students intrigued their motivation and maintained interest, ultimately attributed to attain achievement in basic skill. (Ibid)
- It seemed that running school homepage helped students enhanced in attention span, responsibility/participation at learning, etc. (Daejeon Gayang Middle School, 2000)

FUTURE TASKS

The expectations stated above cannot be reached without teachers who are competent with teaching low achievement students and ICT skill alongside. Teacher training and developing teaching strategies must be sustainable. Periodic and frequent workshops will help as well. Attention also needs to be given to ICT side effect including online game and Internet addiction. Yet there are not many experts on this area who can diagnose what to do to prevent them.

REFERENCES

DAEJEON GAYANG MIDDLE SCHOOL (2000).
Web page-based individualized learning program for low achieving students to attain basic skills.

EDUNET www.edunet.net/cyber/default.asp

GYEONGGI PROVINCIAL OFFICES OF EDUCATION(2002).
National basic skills assessment guidelines for 3rd grade of elementary school.

JEJU SAMSUNG GIRLS' HIGH SCHOOL (2001).
Experimental study on how to advance class instruction in order to attain basic skills.

The publications below are available at these web sites:

*MOE&HRD: Ministry of Education & Human Resources Development www.moe.go.kr
KICE: Korea Institute of Curriculum & Evaluation www.kice.re.kr
KERIS: Korea Education & Research Information Service www.keris.or.kr

KERIS (2002). Educational multimedia content development in 2002.
KICE (1998). How to support low achieving students : Korean, math, and science learning program prototype development for elementary school education.
KICE (1998). Development of computerized test and computerized adaptive test – Mathematics and science for 8th and 9th grades.
MOE&HRD (2003). Current issues and policy directions in 2003.
MOE&HRD (2003). Adapting ICT into school education plan 2003.
MOE&HRD (2002). Basic skills assurances program for school year 2003.
MOE&HRD (2002). Education Informatization Affirmative Action Plan 2003.
MOE&HRD KICE (2003). Basic skills remedial program workshop.
Ministry of Education (1997). Low achieving students support master plan.
Republic of Korea (2001). National Human Resources Development Plan : Human beings, knowledge, and take-off.
Seoul Metropolitan Office of Education (2003). Current status and policy directions in 2003.
Teaching & Learnning Center http://classroom.kice.re.kr

HOW THE EUROPEAN COMMISSION IS MEETING THE CHALLENGE BY FOCUSSING ON GOOD POLICY PRACTICES

Claire Bélisle

LIRE-CNRS, Institut des Sciences de l'Homme, France

Equity in education is an important European goal. Consequently, the possibility of fostering the development of equity in education through ICT arouses great interest and incitement. The European Commission is meeting this challenge through its main "social inclusion" policy, *e-inclusion,* whose objective is to bring all European citizens to the online information society. *E-inclusion,* as information society's potential for social inclusion in Europe, is ensured through education by the development of the basic ICT and cultural skills for a complex and information intensive society. This perspective is presented through the experience of participating in a European Commission ICT workgroup reporting on the attainment of the European objectives for the integration of ICT in education through the sharing of good educational ICT policy practices identified in Member States.

In Lisbon (2000), the European Council set for the EU a specific European goal to be attained by 2010: develop the best knowledge-based economy in the world. This objective, conditioned by the development of information and communication technologies, entailed two strategic expectations from education:

- provide all people with the skills to exploit information and communication technologies;
- ensure that no one be excluded from the benefits of the information society.

Fighting exclusion as the road to equity is therefore inscribed deeply within the *e-inclusion* European policy. Many European policies are now being developed to support social inclusion through *e-inclusion* as this is not the exclusive domain of education, even though only education actions and policies will be considered here.

In this context, the pursuit of equity in the European Union lies initially with education. It is through learning and training that citizens are empowered with the digital culture proficiency that will support job creation alongside social and environmental policies that ensure sustainable development and social inclusion.

In a "knowledge society", education and training rank among the highest political priorities. The European Council has set the objective of making its educative and training systems a world quality reference by 2010. Three basic principles inspire this programme: improved quality, facilitation of universal access, and opening-up to the wider world.

Acquiring and continuously updating and upgrading a high level of knowledge, skills and competencies is a prerequisite for the personal development of all citizens and for their participation in all aspects of society, ranging from active citizenship to their successful integration into the labour market.

As Anna Diamantopoulou, Commissioner responsible for Employment and Social Affairs, European Commission[1], underlined recently: "Globalisation and information and communication technologies have dramatically changed all areas of European working and social life. Today, more than half of all workers in the EU use computers to do their job. And 40% of Europeans use the Internet. (...) Digital literacy – the ability to use information technology – is now as important as being able to read and write. Without IT knowledge, citizens can neither participate fully, nor acquire the necessary skills for our new knowledge society."

The concept of "lifelong learning" therefore underlies the different strategies pursued in Member States to help citizens meet the challenges of the information society.

Implementing equity through education

"Our national education systems differ widely, but they are all faced with clear challenges, and these can only be met if we tackle them together." (Romano Prodi, President of the European Commission)[2] Developing equity in education through ICT is however not an obvious European goal. Education systems are normally outside the scope of European legislation. Therefore strategic European goals and objectives in education cannot be implemented in the same way as the other social and economic goals.

Usually European policies and objectives are initially elaborated by the Commission through groups, committees and ad hoc structures. The ensuing policies, recommendations and action plans have to be endorsed by the Council of the European Union and adopted by the European Parliament in order to become binding for the Member States. A last step is integration in the countries' nation-

1. Excerpt from "Gender and Information Society", *Speech at the European Conference on a Ministerial level,* May 2003
2. Excerpt from "Growing and thriving in a knowledge society", *Speech to the European Parliament*, Strasbourg, 12th of February 2003.

al action plans and legislature. However this does not apply to education which, because of the subsidiarity[3] principle, is the exclusive domain of national and/or regional governments.

The European Union has consequently developed a specific approach to the development of the information society educational objectives. The broader role of education and its cultural aspects is being promoted in a European perspective fully respecting subsidiarity. To attain the EU goals and promote sustainable economic growth with more and better jobs and greater social cohesion, the EU Lisbon Summit called for a new method of "open coordination". The Lisbon Council conclusions indicated that it would use "a fully decentralised approach using variable forms of partnerships designed to help Member States develop their own policies progressively". The Open Method of Co-ordination[4] is described as a "means of spreading best practice" and achieving greater convergence towards the main EU goals. This method is being implemented through the Education Council. Circumnavigating traditional forms of EU policy formulation, this approach calls for setting targets and benchmarking progress, primarily through the EU Council.

The means of implementation of the Open Method of Co-ordination involve tools such as indicators and benchmarks as well as the exchange of experiences, peer reviews and the dissemination of good practice. A key element in « open method of co-ordination » is the benchmarking approach that is being developed through the selection of 'good', 'best', 'interesting' and/or 'successful' educational ICT practices. It is a process driven by participants trying to improve their organisation. However, the benchmarks remain indicative and, in accordance with the subsidiarity principle, it is primarily up to the Member States to take action to follow up the conclusions of the Lisbon summit.

The Member States therefore have full responsibility for the content and organisation of their education systems. Looking at "best or good practices" implies working with a set of parameters defining 'good practice'. Outside of its initial context, a practice that has worked well in one context may not work at all in another. The wide diversity of educational systems in the member states of the EU intensifies this problem, and is seen as an obstacle to the simple transfer of 'good practice' from one environment to another. Therefore "good policies and practices" have to be analysed – goals, strategies, contexts, action plans, results, successes and failures – in order to be profitable for others. It is with this experience in mind that the use of ICT for developing equity is considered.

Equity as an educational goal

Equity in education is an important European goal[5]. It is based on principles of non-discrimination, equality between men and women, and respect of cultural and linguistic diversity. Teachers, educators and administrators recognize more and more the urgent need to counteract systemic discrimination and to provide educational opportunities that address the diverse backgrounds, world views and lifestyles of all learners. The challenge of eliminating sexism, racism and all forms of discrimi-

3. The subsidiarity principle is intended to ensure that decisions are taken as closely as possible to the citizen and that constant checks are made as to whether action at Community level is justified in the light of the possibilities available at national, regional or local level. Specifically, it is the principle whereby the Union does not take action (except in the areas which fall within its exclusive competence) unless it is more effective than action taken at national, regional or local level. It is closely bound up with the principles of proportionality and necessity, which require that any action by the Union should not go beyond what is necessary to achieve the objectives of the Treaty. (Europa glossary. http://europa.eu.int/scadplus/leg/en/cig/g4000s.htm)
4. For more information on Education policies and European governance, see the document by Anders J. Hingel (DG EAC/A/1): http://europa.eu.int/comm/governance/areas/group12/contribution_education_en.pdf
5. European programmes have been contributing to the elimination of discrimination with projects promoting equal opportunities in education and developing lifelong learning. See "EXAMPLES OF EDUCATION AND CULTURE PROJECTS FOR PEOPLE WITH DISABILITIES", the DGEAC press pack for 2003, the European Year of People with Disabilities: http://europa.eu.int/comm/dgs/education_culture/succes/dossiers/hand/doss-presse_en.pdf

nation is a major one because they are so pervasive, incorporated and sustained in the attitudes, behaviours, systems and institutions that shape our society. Many students, particularly ethnic and language minorities and females, are not being served adequately by existing academic programs. The deficiencies of traditional programs – often involving low expectations and unequal opportunities for learning and achievement, – together with changing demographics, economic conditions, and workforce needs, call for unprecedented quality upgrading in education. All students deserve equitable access to challenging and meaningful learning and intellectual achievement, regardless of race, ethnic group, gender, socio-economic status, geographic location, age, language, disability, or prior academic achievement.

A significant contribution to reducing inequity in education is the setting up of twenty-nine indicators for evaluating the equity of European educational systems[6]. The indicators range from contextual information, such as the disparities in income and access to employment, information about the educational process and the results, and information on the social and political effects of inequalities in education. Although some of these indicators are still of an experimental nature, their interest lies in their capacity to stimulate the establishment of more global measures than what has been taken into account until now.

Equity has profound implications for teaching and learning throughout the school community, and can only be ensured if it is at the core of systemic educational efforts, not only in curricula, but in education as a whole. Eliminating discrimination can be tricky and not always obvious. It sometimes involves not treating everyone the same and even offering more to "disadvantaged" students than to others. Equity will be in the results, not necessarily in the opportunity. Equity in education is ensuring equitable opportunity and benefit, and recognizing that to be treated equitably some people may need more or different supports. Approaches need to be broad in scope and recognise the value of different ways of learning and views of knowledge. A specific challenge for school systems today is developing in all students the skills, knowledge and attitudes necessary for the information society. Consequently, the possibility of fostering the development of equity in education through ICT arouses great interest and incitement.

Educational ICT as a means for reducing inequity

Information and communication technologies integrated in education play a paradoxical role in the information society. These technologies offer genuinely new opportunities for the inclusion of socially disadvantaged people, be it because of social, economic or cultural discrepancies, by providing access to high quality information and education. But at the same time they also bring new risks of exclusion, through the digital divide brought about by computer ownership and internet access, or the knowledge gap, between successful learners and dropouts, that increases in an information intensive society. Furthermore, digital exclusion is often cumulative with other social disadvantages that education systems cannot eliminate, and that are experienced by disabled persons, elderly persons, unemployed, low income households, ethnic minorities. These disadvantaged groups are vulnerable because they are composed of people with physical, personal or social handicaps, such as relatively low skills and education levels, or literacy difficulties, or because of enduring racist or gender biases. These are people who were already likely to be disadvantaged and who are expected to have more difficulty if not impossibility in participating in, and benefiting from, education in an information society.

6. Important work has been done on indicators for assessing equity in educational systems by the "European Group of Research on Equity of the Educational Systems" with the report: *Equity of the European Educational Systems*. A Set of Indicators. See: http://europa.eu.int/comm/education/programmes/socrates/observation/equality_en.pdf

European-funded research projects have been exploring the educational use of ICT to help overcome inequity and facilitate for disadvantaged groups the access to information and skills strategic to employment. Because there is only a very limited range of multimedia products on the market suitable for overcoming physical handicaps, the design of dedicated multimedia tools has been addressed in Multimedia Task Force projects such as EVIDENT (European Versatility in Deaf Education using New Technologies), or SMILE (A Sign Language and Multimedia-based Interactive Language Course for the Deaf for Training in European Written Languages). Other projects, such as FLEX, (Flexible Learning Environment Experiment), were focused on more social disabilities in trying to offer to children of families working in circuses, fairgrounds or on barges creative and innovative education solutions based on GSM and satellite communication and the Internet.

These projects have provided precious insights on the educational benefits of IC technology, but also on the need to embed deeply within the cultual and social practices of these groups the new innovative educational activities if they are to be lasting.

The main objective of the European Union education policy is "social inclusion" through *e-inclusion:* bring all European citizens to the Net. The critical factors or means for attaining this objective with underprivileged groups are 1) setting up a supportive creative educational environment, 2) development of basic skills and digital literacy to use digital technologies in daily life, and 3) access to online and technology-based information. The rationale is that through ICT, these citizens can be better provided with higher quality educational opportunities and thus have an equitable access to the riches of the information society and the knowledge based economy.

Challenges facing equity education with ICT

With the integration of ICT in classrooms, we observe the emergence of fundamental changes in education. Education today happens in a new context characterized by the diversity, the hybridity and the multivoicedness of students, often overwhelmed with information and the perspective of lifelong learning. The challenge here is to reach students beyond their diversity, and increasing boredom for school activities which, they feel, draw them away from real life. At the same time, schools are pressed to open up to the outside world, with more interactive and student-centered learning environments, and growing exchanges with local communities. Furthermore, teachers are expected to train students for new socio-cognitive skills (perhaps not necessarily new but perceived as such) that are required by the ICT based information society: constructive learning, information processing, critical thinking, problem solving, collaborative work, and communication skills.

ICT tools and practices, while opening new accesses to information, place new demands on learners and teachers. Training students in ICT basic skills is considered as one of the objectives for students to "enter the digital and media culture". However, there is not yet consensus on how this digital literacy should be generally defined and addressed in the school curriculum.

An important question deals with the impact of ICT on the gap between learners with low academic results and those with high achievements. Rightly or wrongly, fears regularly come up linking ICT to those learners having more financial and intellectual capacities. How can ICT promote greater equity in educational opportunity and achievement, thereby "fighting social exclusion and strengthening social cohesion"? One perspective is to accommodate with ICT the increasing variability in learner profiles, and especially those with specific handicaps. More information is needed on whether brighter and more autonomous students fare better with ICT or whether the integration of ICT in education can foster the development of self-confidence and autonomy.

An initiative addressing these problems is the Socrates project EVA, set up to develop ODL (Open and Distance Learning) for "youth at risk". Having chosen to work with disadvantaged target groups at the local level, the project partners (from Germany, Spain and the Netherlands) were confronted with the social premises of classic Distance Learning which is based on an ideal learner, intrinsically motivated and capable of studying by his own independently. In the complex social context involved, the learners' personalities, their initial social heritage and previous integration made it difficult for them to identify meaningful educational targets.

The EVA project provided an alternative to the common model of classroom learning, considered responsible for a number of disappointing experiences among young people. Jointly with the young people, the partners had developed products following the method of Software Design by Learners (SDL), had set up a virtual learning environment with an online-classroom, an internet café, a chat, a newsletter, etc. The project partners found that in the ODL context, understood as extending the classroom boundaries and learning categories, learning happened in as much as the young people were linked to real classrooms. In other words, such internet-based dynamic learning arrangements succeed inasmuch as they are perceived, by the groups involved, as close to their interests, educational backgrounds and social contexts.

The two key actions set up by the European Commission, *e*Europe and *e*Learning, are of particular interest for the challenges education systems are facing. The Barcelona European Council called on the Commission to draw up an *e*Europe action plan focussing on "*the widespread availability and use of broadband networks throughout the Union by 2005 and the development of Internet protocol IPv6 …. and the security of networks and information, eGovernment, eLearning, eHealth and eBusiness*". *e*Europe 2005 therefore aims to stimulate secure services, applications and content based on a widely available broadband infrastructure. *e*Europe is part of the Lisbon strategy to make the European Union the most competitive and dynamic knowledge-based economy with improved employment and social cohesion by 2010. It opens up opportunities for powerful multimedia tools capable of offering to disabled persons access to customized training services and resources.

The focus on the learning process raises new demands on the education system, for example in terms of better guidance and tutoring services to be provided to the learner, that take into account different learning styles and different levels of aptitudes.

The European Union has already financed several projects aimed specifically at putting more equity in the educational systems. Out of over eight hundred projects, coming from ten different programmes, presented on the *elearning* Portal[7], only a small fraction address equity issues. These projects address specific learning process issues as well as adapted technological solutions. A few examples are: ELDA (E-Learning Disability Access) is a project aiming to develop a Virtual Community of Electronic Learning for disabled people, allowing them to overcome access barriers and to fully realise the potential of tele-training and tele-communication for this category of student; AAOutils (Architecture and Accessibility – Tools for Training) is a project aimed at producing vocational training programmes in accessible architecture in favour of physically disabled people via Internet (Leonardo da Vinci); INACANI (Investigacion en la Accion Educativa Intercultural: Animacion Interdisciplinar), is promoting the integration and the development under equal opportunities of disadvantaged social groups (Comenius); NPB (Network for blind people) is a project aimed at setting up a European multimedia network allowing blind people to access, through adequate equipment, the data bases of all participant libraries and all information presented on the Internet. It intends also

7. The address of the eLearning Portal is http://www.elearningeuropa.info

to develop curricula for distant learning fitting the requirements of blind people and specific communication channels for them (eLearning initiative); Bookworm goes on line (Alliance for a Media Literate Europe) is geared to girls and women with a low level of education and different social from cultural background are targeted. The women are trained in analysing, selecting and evaluating information through setting up and contributing to their own on-line magazine(eLearning initiative); Stepping Stones (Inclusion in Vocational Training for People with Learning Disabilities) will develop a specialist multi-media software package to allow those with moderate or severe learning difficulties to explore opportunities for vocational training and employment (Leonardo da Vinci); Am disabled – Have experience: (Software for Training and Testing the Physically Disabled for Telework in Customer Relationship Management) will address the needs of disabled persons in gaining professional or work experience (Leonardo da Vinci).

The *e*Learning Initiative aims to enhance the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration. This initiative has four initial components: to equip schools with multimedia computers, to train European teachers in digital technologies, to develop European educational services and software and to speed up the networking of schools and teachers. Most of the resources mobilised are national, but they are backed by all the adequate Community instruments (the education, training and youth programmes for innovative actions and exchange of good practice, the Structural Funds for assistance in the eligible regions, the IST to support research and to promote European digital contents) and by the development of partnerships between public authorities and industry.

The *e*Learning initiative of the European Commission seeks to mobilize the educational and cultural communities, as well as the economic and social players in Europe, in order to speed up changes in the education and training systems for Europe's move to a knowledge-based society. In order to ensure equity, specific challenges must be identified and met. *e*Learning is a renewed opportunity for public education to meet its commitment to provide equitable educational opportunities and benefits for all students, such as

- inclusion of students with exceptional needs in regular classroom;
- providing integrated social, health, justice and other services to students at risk of school failure because of social and emotional problems, such as poverty, family breakdown, violence, neglect, and teen pregnancy;
- fostering gender equity through positive interaction and growth between students of the two sexes;
- providing students of minority faith with access to an education consistent with their religious practices and values;
- providing equal access to a high quality education for all students wherever they live, in urban, rural or areas.

In launching the initiative "*e*Learning. Designing Tomorrow's Education", with its corresponding action plan for 2001-2004, the Commission has laid the foundations for concrete and sustainable action, through a set of specific measures. These measures serve to co-ordinate the various *elearning* activities of the EU and propel it towards the knowledge based economy and the vision set in Lisbon.

Member States are urged to develop policies that tackle technical barriers with the development of assistive technologies; motivating strategies and methods based on multimedia; culture sensitive content, core specialised vocational skills, flexible training tailored to individual needs such as unemployed, migrants or students with special needs.

CONCLUSIONS

The educational use of information and communication technologies nurtures much hope for the advent of a more equitable society. Faced with the many challenges of a knowledge intensive society, educational policy makers need to foster a reflexive approach to ICT integration in education. Educators need to reflect on existing results and data and develop adapted practices and this requires critical thinking and reflection. Problems are just beginning to be identified and new frontiers are being tamed as information and communication technologies develop and provide new opportunities for human development and interaction. It is a characteristic of the European approach to integrate a permanent emphasis on *e-inclusion* objectives and to take advantage of the relevant features of information and communication technologies to enhance learning opportunities for all learners.

Besides state and national educational ministries, regional and local actors, social partners and civil society organisations have a key role to play in the development of a high quality equitable educational environment, increasingly accessible to all learners through the use of ICT. European policies serve as strong encouragements for coherent e-inclusion strategies in Member States. Sharing successful practices allows educators to benefit from existing experiences and to choose the best ways known of achieving common goals of equity through *e-inclusion*.

HOW USEFUL CAN ICT BE IN IMPROVING THE QUALITY AND QUANTITY OF EDUCATION FOR SPECIAL GROUPS?

COMMUNITIES AT DISADVANTAGE: REINVENTING ICT BASED LEARNING OPPORTUNITIES.

Marcela Santillán Nieto

UPN, Mexico

1. PROBLEMS AND SCENARIO.

1.1. The Latin American Context.

1.1.1. Diversity as the source for richness and poverty.

An exploration of the Latin American region shows a strong integration of multiple cultures, coexisting under a common language, but embracing a large diversity, which is reflecting extreme situations for those groups now in exclusion, which represent the highest growth of the society. Repeated and subsequent socio-economic crisis are responsible for outrageous increment in the individuals, families and groups incorporating into the marginalized, extreme poverty and exclusion sectors.

As a result, migration flows are larger than ever people, looking for opportunities they don't find in their own land, mostly from the Indian population. A large convergence of social problems is then represented. Marginalization and exclusion is critically associated with extreme poverty, and usually behind the reasons for illegal migration flows, in most of the countries, throughout borders. Latin America is well known by the internal migration movements that create the "misery belts" around major metropolitan areas. Mexico City exhibits a very large indigenous population in marginal areas around the city, as a result of settlements made up over the years from daily flows of indigenous people.

This convergence shows up directly linked to the traditional gender based unbalances, observed in the opportunities and in the access to development. Evidence is found everywhere of the infamous (ITP) "Intergenerational Transference of Poverty" attributed mostly to having exposed the weakness of the ill prepared young women against the hard mission of raising a family, frequently alone.

In order to determine what actions help to alleviate poverty, what works and what does not, what really generates changes over time, poverty has to be defined, measured, and studied. As this notion has so many dimensions, it has to be observed via a variety of indicators — levels of income and consumption, social indicators, and indicators of vulnerability to risks and of socio/political access, particularly participation in knowledge based societies.

It is precisely because of the arrival of the knowledge based society that some sectors of our communities are now more conscious of the meaningful value of our strong diversity as a new driving

force for prosperity and a source for richness in a new era. An unprecedented opportunity emerges for those under exclusion, to be part of the proposals raised under the ICT influence, breaking the inequality status they are condemned to.

Inequality means different things under a variety of contexts: whether inequality should involve ethical concepts such as the desirability of a particular system of rewards or simply mean differences in income, is still the subject of intense debate. It is useful here to adopt the notion proposed by *Poverty Net* specialists: "We will conceptualize inequality as the dispersion of a distribution, whether that be income, consumption or some other welfare indicator or attribute of a population". (The World Bank Group, 2003)

It seems worth mentioning one additional sector that is also undergoing severe exclusion. The population generally labeled as "the handicapped". Several social diseases are reflected in how the community treats these groups, whatever the disability. Performance of political and social response are lacking, by far, an acceptable level to allow a real integration of this population both to a learning and to a productive life. The subject calls for a different response for the new times.

As a result, of all these sectors observed at some kind of exclusion, it is clear that the learning processes for them can be greatly benefited by the inception of ICT. However, *Global Initiatives* to create technologies for human development are needed, as well as, *National strategies* to develop creative, decentralized, widespread, and focused responses in the network era. (UNDP, 2001)

When exploring learning and the "Digital Divide" issue, it becomes clear that ICT has a fundamental role to play in favor of very specific groups, not only because they deserve the same expected benefits as other groups in society, but mainly because new technologies perform for them remarkable equalizing effects, when programs are focused on their needs. Most of these groups fall under general categories like:

- The socially excluded
- The extreme poverty groups
- The marginal and geographically remote
- The indigenous population
- The linguistic and ethnic minorities
- The groups with special needs and disabilities

1.2. The case of Mexico.

Mexico is one of the 10 largest economies of the world, and simultaneously exhibits one of the worst imbalances of income distribution, thus creating a difficult international index position both for social development and for competitiveness.

Poverty in Mexico is a complex multidimensional phenomenon. Broad social investment has taken place in the country, targeted on human capital development, promoting income and employment opportunities, improving physical infrastructure and funding basic education and healthcare even for groups without coverage.

Reforms undertaken after a very serious economic crisis in 1994, have lead to a remarkable recovery, within a severe fiscal discipline, keeping a growth route, being again a graded borrower, and participating performer in commercial and financial integration. Analysts observe that particularly commercial openness, one of the largest in the world, was not accompanied by international agreements on people and jobs flows, and cultural, scientific, educational and juridical complementary strong agreements.

Another remarkable situation is that Mexico can be viewed as a strategic gateway, integrating with three axes, an interesting crossroads position. It is viewed as a "head" of all Latin American nations, by being a country that signed free trade agreements with all of them, and acting bonded to a very respected external relations policy. On another axis Mexico is one of the North American Free Trade Agreement (NAFTA) partners, along with Canada and United States. By becoming a member of the OECD a visible enhancement of relationships with European communities has been achieved. All of that, representing a considerable potential for extending international collaboration circuits, beyond commerce. International acknowledgement has been general on the mature political transition process held in 2000. Many political and economic challenges are waiting ahead.

In terms of education, Mexico is stepping into a broader challenge, to bring the system to a higher level of quality, even more compatible with the demands of a modern economy. According to Marcelo Giugale in a book published by the World Bank: "The current teacher centered teaching model, which effectively emphasizes memorization to the detriment of comprehension and was designed for the average student, has to be abandoned in favor of cooperative, student driven learning by investigation, where the teacher is not the source of knowledge and the custodial controller of the students, but, rather, a class facilitator." (Giugale et al., 2001).

Such a paradigm change involves deep reform in areas like teacher training, curriculum, and administration, in order to allow several different models and creative options competing through the public systems in different regions.

Just as a brief illustration, "Opportunities for the Young", led by the Federal Secretary of Social Affairs is one of the largest social coverage programs in Latin America, distributing 4.5 million scholarships for 3rd to 12th grade students, allowing access to 21 million individuals from families in need at rural and semi-urban areas. The Secretary of Public Education provides free compulsory education to 38 million Mexicans ranging from Pre-school education (a recent decision approved by Congress), to preparatory level. Mexico also finances 87 regional higher education institutions, and two major universities recognized among the largest in the region, the National Autonomous University of Mexico (UNAM) and the National Polytechnic Institute (IPN). A national institution, CONAFE, has been designed solely to assist poor and rural communities. Additional exploration of its policy is available at their web site. [See: www.conafe.edu.mx]

1.3. The double exclusion status.

1.3.1. Permanence and growth of traditional exclusion conditions.

Income levels, rural or urban settings, the educational level of parents, nutrition and health are just some of the factors limiting access, achievement, and permanence of children in learning situations. The filter imposed by this combination of factors is extremely rigid and difficult to surpass.

Particularly severe is the intergenerational gap in developing countries, where the coverage, quality and diversity of the available learning opportunities still shows significant deficiencies. In most cases, the services growth rate is insufficient to meet current needs. One known deficiency refers to adult education and workplace training, both of which lack adequate pedagogical models and sufficient financing.

Cultural, ethnic and individual factors may also play an important role in determining educational inequalities within institutions and society. For example, inequalities stemming from gender dif-

ferences or individual learning abilities are generally accentuated by rigid and conventional school systems, which reflect and reproduce the dominant social practices and prejudices.

1.3.2. Emergence of new exclusion factors adding up to traditional ones.

The rapid innovation processes in information and communication technologies (ICT) has led to their increased impact and relevance in the educational field. These technologies show a stronger pedagogical potential than they did just a decade ago, not only in the diverse spectrum of alternatives to deliver open and distance programs, but also in the improvement of the traditional school teaching and learning methods at all levels. Recent findings also point to the observed impact on most non-formal learning systems. Community learning, corporate learning and many other forms of learning outside school have been favored by ICT, directly confronting the emerging gaps with nontraditional options.

In an analysis made for the OECD sponsored "Learning Inequalities Roundtable" according to Guillermo Kelley, (2004): "To prevent this situation from perpetuating itself, many compensatory programs are needed, such as those aimed at supporting education for women and specially challenged individuals. The appropriate use of ICT may have a significant impact for mitigating gaps within academic institutions. This is so because through their efficient use, participants with different learning abilities and backgrounds may receive individualized educational services that cater to their specific needs".

1.4. Building a gender –sensitive global knowledge society.

Analysis has to depart from two deeply rooted situations in most Latin American countries: extreme poverty, and the marginal situation in rural areas. The problem can be described simply as reaching out to women in rural regions, where policy making deals with a few identified "fundamental problems" and has little or no contact with the outside world. A Development Gateways specialist (Development Gateway, 2003) summarized: "The rural dimension of women's issues is not receiving the attention that it ought to".

In addition, a new dimension of problems arises when a knowledge based society appears, and most traditional approaches are to be "exported to the new emerging civilization on the net, then extending discriminatory practices and very low services, content and access strategies linked to a gender insensitiveness". It continues to be very difficult to find real committed programs and strategies directed to ensure women's participation in the new learning and economic opportunities.

It is fair to say that discriminatory practices or exclusion of women in Latin America is less critical than in some other regions of the world, but recognizing that the situation is still less than acceptable. Particularly for Mexico, with a population of 53% women, schooling and opportunities nowhere near that proportion.

1.5. Indigenous knowledge protection and promotion.

Besides opening wider access for indigenous communities to learning options, a new responsibility has to be kept. Local or indigenous content needs to be identified and protected. Local content can be seen as the expression of a community's knowledge and culture in their own languages.

This, however, is not a simple task. For example, when facing the task of local content identification, typically, teachers or promoters working in areas with large indigenous populations exhibit lim-

ited local language skills—many speak the local language but do not have reading or writing literacy—and are ill-prepared to teach the indigenous people in their own languages. Training opportunities are also inadequate, particularly in the associated areas of active learning and intercultural understanding.

Training programs for teachers and community promoters need to strengthen instruction in indigenous language literacy and cultural concepts, first and second language learning and bilingual pedagogy, multi-grade teaching methods, and cultural sensitivity to help students bridge the gap between home and school.

Colossal challenges lie ahead when promoting incremental and focused attention to learning spaces for indigenous communities, a serious problem that has yielded very traditional programs. But ICT can be a powerful and innovative ally to overturn the situation.

1.6. Equitable and inclusive access for the disadvantaged and marginalized

One of the hypothesis about ICT it its ability to reduce imbalances and to open unprecedented models for those excluded from the traditional learning systems, either formal or non-formal. Teaching then, seeks to empower individuals to choose and to jointly build the learning communities they belong to.

Groups Consulting to UNESCO, confronting the question of what to do to help the disadvantaged and marginalized have observed: "...it involves a supra-national effort in critically rethinking some of the basic assumptions, processes, roles, relationships, approaches and discourses underlying conventional education systems and in creatively constructing new learning communities, and environments in which such communities can flourish, that are more responsive to diversity of learning needs, (meta-)cognitive styles and cultures". (Matsuura, 2003)

1.7. Learning without frontiers. Itinerant and Migrant flows

1.7.1. The universal approach.

For Latin America, a creative concept like "borderless learning" may carry a twofold meaning. On one side, a learning strategy that follows people "down the road", even beyond local or national limits, and on the other side, a learning proposal that does not imply a threshold nor a ceiling for the concepts or the mind. Migrants or Itinerant workers are precisely the kind of population seeking an innovative answer, beyond the traditional limits, which helps them to complete the process where they are, when they can.

Obviously, this is not easy at all. But today´s ICT promises to help in the creation of a new response. It becomes useful to reference the visions around UNESCO's approach to the concept by stating "...as a transdisciplinary initiative, "Learning Without Frontiers" represents a pro-active response to addressing the deep social and political problems that confront humanity as they relate to the role of learning in society". (Learning Development Institute, 2003)

Under a broader approach the statement continues to make a difficult point, by envisioning new learning ways for communities and individuals, which are very different from the formal ones, in this case, very suitable ones for migrant population: "..It views the processes of engaging in collaborative, multi channel and innovative learning as being critical for both the development of the individual

and the building and linking of culturally diverse communities. Learning ((meta-) cognitive and socio-cognitive processes that we engage in *together* in all spheres of our lives) is differentiated from traditional notions of education (products that we transmit to others through schooling, whether in a classroom or through distance education)." (UNESCO, 2003)

1.7.2. The local approach.

Migratory flows inside the country are now quite evident in Latin America and well known as "Misery Belts", mainly surrounding large cities. The case of Mexico City is shocking. It is said, that indigenous populations are larger at the city than at the original locations for certain groups.

The situation reached at border points has become one of the major political and social concerns. In Mexico, both the border with Guatemala, and the Border with the United States are illustrative of the unacceptable situation. It is impossible to describe the impact on the learning opportunities at these locations for the migrants, as well as to imagine a solution. ICT offers innovative options for a different kind of learning for these people. It is time to see if new technologies perform beyond corporate slogans.

1.7.3. Learning on the way. Migrant educational responses.

Both cases, internal flows from rural areas into metropolitan areas, and flows from the interior of the country into another country, surely require non-conventional answers, and innovative proposals on demand for migrant populations beyond the reach of traditional educational structures and educational governance.

One of the ideas to consider is that instead of a definition of service, "waiting for the user to come", a modern approach has to be designed for the service "to look for and follow the user". The most recent methods point at subjects like "learning on demand" or "tailor made curriculum" or "learning without distance" (instead of distance learning), departing from the hidden paradigm dictating a central institution delivering to those at the periphery.

If tools are really available for allowing "business on demand" for commercial corporations, as well as "learning on demand" strategies for advanced academies, it can be true, that this time the ICT tools must help re-invent learning opportunities that "follow" the individual or the communities, particularly in an itinerant or migrant situation.

1.8. Barrier free technology. Independence for the handicapped

There is still a great deal of ignorance and misunderstanding, even among Internet professionals, about how to realize the potential of the Internet to provide access to people with disabilities. There are affordable, elegant, and easy-to-use tools and design techniques that can make information tools and even Web sites dramatically more accessible to people with a variety of disabilities - including those who use assistive technologies and/or hardware that is less than state-of-the-art.

Smart and affordable devices to enable the handicapped will greatly reduce inequality. This is an urgent call for designers and manufacturers, considering the progress achieved in areas like wireless device communication, interfaces accepting mechanical, optical, and even voice command.

2. PROGRAMS AND ENDEAVOR.

2.1. Some showcases in Latin American countries.

No need to stress that a great variety of important projects have taken place in Latin America that easily illustrate how ICT, associated with a learning objective, has created environments beyond the original designs. With the choices at hand and with the limitation of a very brief review of large and long term endeavors, an illustration is depicted below.

2.2. Proinfo-Brazil.

Proinfo has been the largest endeavor ever undertaken in Brazil to offer an integrated solution based on a TV educational proposal, linked to the creation of a large infrastructure of computers for schools. Large figures surround the project in the number of states and small municipalities covered, of students, teachers, parents and communities, of T. V. programming hours, of access to computer servers and web sites, and of training areas. In some cases, those figures exceed regular numbers at European nations.

This effort involved all federal agencies dealing with education, state governments, municipalities and private sector participation. Economic crisis in the country significantly reduced the targeted goals for the complete program, but it has still become a landmark in terms of socially legitimizing concepts like distance learning for poor communities, teachers forums on the net, and many others.

However, the specific focus on non formal education and attention to populations under severe exclusion, still remains a goal to achieve. Additional information can be found via the link below.
http://www.proinfo.mec.gov.br//

2.3. Solar Villages Honduras.

Established within the framework of UNESCO's assistance to Central American countries affected by the hurricane Mitch in October 1998 - Honduras, Nicaragua, El Salvador and Guatemala, the first solar village "José Cecilio del Valle" was installed in Honduras in the spring of 1999. This village has become the first demonstration solar village (843 habitants) in the region and gave rise to a great deal of interest in a number of other rural communities.

The issue to remark is that a re-invention process took place when in front of the tragedy and full devastation of the villages' infrastructure, a traditional reconstruction process had no sense, and responses for the difficult questions in front had to be found directly at the place. Solar villages made a complete redesign of the village concept, and became strongly inspired and influenced by the idea of turning it into a "learning community". That is why computers and internet technology became a natural solution when, in the middle of the disaster, this idea simply seemed absurd. A link is included for immediate reference. (http://www.unesco.org/science/wsp/country/honduras.htm)

A solar school is being developed in Samanzana, Guatemala, with the support of the Organization of American States, based on the experience of the above-mentioned solar village in Honduras.

The present administration in Honduras has created a new project named "Comunitec" built capitalizing on the experience sponsored by UNDP, OAS and UNESCO, and now sponsored by the Vicepresidency, the MIT Media Lab, and the OCCAM Observatory. Comunitec aims to propagate in the

country the same approach not only for rebuilding villages, but to relocate, and mainly to promote the adoption of ICT as a major tool for living in the communities.

2.4. Special Network Argentina.

This case is a great example of the initiative taken to assist the handicapped population and those with special needs in Latin America to become part of the knowledge based society, mainly, as an example of international collaboration and service. The Organization of American States (OAS) and SIDAR in Argentina created an Internet portal of services, bringing the support of the Web Accessibility Initiative.

This innovation contributes to many sectors linked with this population via two strategies. One of them is by providing services to enable people to use ICT for their own learning benefit, and to help them raise employability skills and even find job opportunities. The other one is by creating recommendations for systems designers, technology developers and even users, to facilitate access, enhance performance and create special features of the services for the handicapped and special needs population.

Links are incorporated here for immediate additional reference.
http://www.redespecialweb.org/accesibilidad.htm
http://www.w3.org/WAI/

2.5. Mayan Route- Guatemala.

A multilingual web site has been created for the Mayan region in Guatemala, using not only Spanish as a convergence language, but also four other major dialects and indigenous languages, in an endeavor aimed at allowing, for the first time, the inception of Internet based services for those communities. Care was taken in making the communities themselves become owners in the content and directors of the operations of this project.

The richness of the Mayan culture, and the severe poverty and exclusion in this area, reflect the complexities of the endeavor. Several very difficult issues emerged, ranging from the lack of fluency in Spanish to political issues surrounding exploitation of the community resources.

See reference in the link below.
http://www.ebiguatemala.org/article/frontpage/1

2.6. Tele-centers Pan American challenge.

2.6.1. Somos telecentros declaration .

The remarkable aspect of this initiative is the long term promotion and evaluation of an ICT powered. Community Learning Center. Several countries participated, and the array of experiences is surprising. Rigorous definitions and examples, sound technical assistance, fair training, and interesting results are some of its attributes. From the experience emerged several autonomous organizations and leading projects worth following.

Somos@Telecentros is a network of centers for access to the new information and communication

technologies in Latin America and the Caribbean. This project is open to all individuals and institutions who are involved in developing community Internet access centers (Telecentros/Telecenters). The Somos@telecentros Virtual Community is part of the TELELAC (Latin American and Caribbean Telecenter Network) Project coordinated by the Chasquinet Foundation (Quito, Ecuador) and supported by the PAN Initiative of the International Development Research Centre (IRDC, Canada). A board has been recently created presided by a Mexican expert.
http://www.idrc.ca/pan/telecentres.html

2.7. E-Mexico federal initiative

2.7.1. Hard institutional negotiation.

One of the first projects to create a coordinated institutional action to incorporate ICT into major spheres of national activity was the "National Connectivity Agenda". One of the lessons learned is just how hard it may be to achieve institutional integration.

Mexico announced in 2001 a large national program created by a federal executive order, known as e-Mexico. The project demands the collaboration of various Ministries and we may foresee many obstacles along the road, but this is an excellent blueprint for a national strategy that drives all sectors into a renovated interest on the role of ICT in society, wit the focus on disadvantage groups.

2.7.2. E-Mexico and Education beyond sector.

Although it is not intended to review the e-Mexico initiative in this paper it is highly recommended (see active link below). It must be noted however, that it is by far the most important initiative undertaken in Latin America for the sake of ICT inception in key aspects of National life. Following a notion to instill a "Digital Nation" approach, e-Mexico considers four major areas of influence: e-Economy, e-Government, e-Health, and e-Learning.

The attainment of e-Learning entails some major issues like goals and services definitions, inter-agency coordination between federal, state, municipal, and local authorities and institutions, as well as the viability of their combined services.

The Ministries of Communications and Education under a presidential directive have developed *e-learning* as a specific program coordinated under four guidelines:

- Content development
- Human Capital Development
- Innovation promotion
- Research, evaluation and planning

2.7.3. Community definition and services provision.

The concept of community itself is undergoing a harsh under this project. This is not a trivial exercise, and the more alternative definitions that show up, coming from specialists and even from the communities themselves, the more different options of users, services, and promoters profiles turn up.

A remarkable issue emerges when the definition for the plazas includes the concept of "learning community". This requires going beyond space, equipment and training elements, placing a high importance in the cultural workings of the community.

2.8. SEP ILCE SchoolNet (Red Escolar and Encyclomedia)

2.8.1. Digital content endeavor

The Secretary of Education, SEP along with the Latin American Institute for Educational Communication, ILCE developed a project to provide infrastructure for schools towards the goal of establishing a national school network. In parallel, a major concern has been the production of content to be distributed via the internet. A first achievement has been to develop and electronically distribute innovative content, in addition to the electronic publication of all textbooks provided by the government for public basic education.

2.8.2. Linkage between Encarta and Official digital textbooks.

A step beyond has been taken with the creation of "Encyclomedia". This is a project allowing students at the school to actively review official textbooks and new materials being produced as digital content for elementary education, via an internet connection. A set of Hyperlinks in a database also empowers the students to obtain automatic connection and extension for further exploration using the latest available version of the Encarta encyclopedia.

Other steps are directed to empower students and communities to create their own material and link together local content with the Encyclomedia national project.

2.8.3. SEP ILCE Edusat

In a large endeavor, ILCE-SEP also set up a large network dedicated to satellite educational television. Several channels are devoted to this purpose using the service of the largest collection of spanish language educational materials in video format provided by the Ministry.

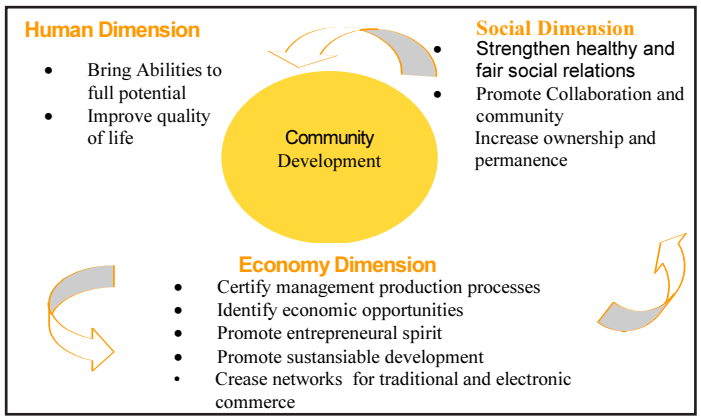
Additional information is presented in a recommended link, to explore ILCE projects.

2.9. Learning Community Centres ITESM –Sedesol

Created as an initiative of the ITESM technological institute, this project is guided under the concept of a Community center with three dimensions: Human, Social and Economic. It is defined as an Internet connected place in a community aimed at providing learning experiences for community members, mainly with the purpose of promoting developmental processes.

This project is made in coordination with the Federal Secretary for Social Affairs

http://www.cca.org.mx/homedoc.htm



2.10. Digital Culture Centres -TELMEX

Born as a strategic agreement between TELMEX, the largest telephone and digital services consortium in Latin America, and the renowned Media Lab at Massachusetts Institute of Technology –MIT, the centers are focused on four major objectives:

- Promotion of research on new technologies adapted to Latin American environments
- Professional development of specialists.
- Technology transfer processes
- Promotion of digital culture

The project has been defined as a mid term agreement for five years mainly involving the creation of a central facility for exploration of digital technologies, learning environments and social response, and several regional centers defined as "Collaborative Learning Hubs". A major focus is directed to the development of local digital solutions (hardware, software, networking) to be incorporated into the fight against poverty and exclusion.

http://telmex.media.mit.edu/convenio.html

2.11. Banamex Foundation

In a remarkable example of collaboration between the public and the private sector, a serious Educational-productive proposal has been launched to generate self-managed, sustainable and productive indigenous organizations. (Banamex Foundation). Using a methodology of proven efficiency, synergies are sought by integrating local institutions and redefining public role in rural areas. A Community Learning Center is created, playing a double role to assist rural development and to enhance local education, by providing specific projects and information based services.

The strategy, in the proposal, looks for real change local managers, integration of groups and institutions, and redefining the function of traditional technologies and practices. Leader development is based on four modules addressing issues like:

- learning for sustainable development,
- project viability assessment,
- technical innovation, and
- planning.

ICT play an important role, but are deeply integrated to local learning and development at each specific indigenous community.

Santa María Tlahuitoltepec, a rural indigenous community in the Oaxaca mountains, (southern Mexico) serves here as a showcase to examine real contributions of ICT to allow marginalized, excluded, poor and indigenous populations to gain access to the information society and to assist their local development, not only keeping but enhancing their identity.

This is a purely indigenous educational model with three major attributes:

- Developed and built by the community itself.
- Meets local needs and aspirations
- Fully based on their own cosmo-vision, philosophy and language.

The model has been built from within, with participation of all key actors, organized around local projects driven by students with social impact in the area, fully supported by ICT infrastructure.

Strong community bonds are shown within the curricular structure, even covering extra-school activities. Life skills on agriculture and craftsmanship are shared with computing abilities and internet communication looking for sustainable projects.

The extension of these objectives is now reaching the creation of a local technological institute, and the improvement of the elementary school. Strong local and international assistance has been present in the development of the project with a careful approach and close supervision from community members themselves.

Looking for an integral view, this region is well known for the high musical skills found in all of the population. A center for musical education has been established, with strong supervision by the community. So far the whole model has operated:

- Without formal legal structure,
- Without a regular administrative structure
- With a fragmented and insufficient budget
- With non-regular, case by case external support and funding.

It is worth mentioning that this community has seen the integration of almost all federal initiatives described in this document, this turning into a showcase and experimental lab on the impact of each of these programs, even allowing comparison of methods, and strategies. Also, this community is strong enough to reject, cancel or totally redefine some of the projects. It has become a two-way reinventing lab where communities and authorities are learning new lessons every day.

3. PROSPECTIVE AND COLLABORATION.

3.1. Sustainability issues.

3.1.1. Focused strategies for special groups.

The observed ICT evolution has become a renovating force for educational systems, and turns out to be a key element for contemporary development of meaningful learning.

However, the expected changes are not visible in today's educational context, and transforming this reality demands concerted participation of all those institutions that legitimate and promote the incorporation of ICT for learning spaces, specially for disadvantaged communities.

Nowadays, development of knowledge is deeply related with the development of ICT. This interrelation exhibits profound incidence on the design of new learning systems. One of the major education goals is to develop an individual capable of actively participating in the contemporary culture, and this necessarily involves teachers and promoters as well, as it commits their development and their ability to respond when faced with the need to interpret and govern an emerging reality.

As a general policy recommendation, focused efforts in favor of the disadvantaged should mean specific institutions, setting apart funding, dedicated development of necessary resources, and committed will, to reach the populations where they are, promoting their own empowerment to help themselves modify the status. An example, in the case of Mexico, has been the creation of CONAFE (National Council for Educational Promotion), an institution totally dedicated to create projects and administer resources solely dedicated to the rural, Indian and disadvantaged communities. Incorporation of ICT has become the greatest challenge to face this time. (Sedesol, 2003)

3.1.2. Critical assistance. Models and design.

An area for improvement world wide, and very inclined to international cooperation is the one related with academic projects design and operational models in favor of the disadvantaged. Be it physically challenged, indigenous or immigrant groups, experiences around the world show how positive the multilateral approach can be to exchange lessons learned and policy recommendations.

The importance of departing from very creative initiatives and projects design, as well as proven models and innovative approaches, particularly in the presence of ICT, becomes apparent when the expectation is for the poor communities themselves to undertake the responsibility to help design and implement the projects, going beyond the traditional approach which assigns them a passive role. Better knowledge about the design and the models will allow for more local empowerment and active participation. This again, is a new paradigm, where the disadvantaged take an active part in embracing learning opportunities, in a true re-invention of the concept and of its practical implementation.

3.1.3. Funding.

Despite the extraordinary efforts made to increase public funding for Educational purposes, new challenges continuously appear. This includes efficient welfare management where governments need to complement resources allocated with private ones, but this is still marginal and difficult. Tools for performance assessment to ensure value of investments and strategies for re-distribution of costs in more equitable ways across the system are being created or refined every day.

OECD stated in 1999 that there are good reasons to shift resources to younger children, specially towards the socially disadvantaged, since there are high social returns for investments in this group. General policy observations are:

- Improve monitoring on the destination and level of use of public funding.
- Extend services while maintaining cost increases at reasonable levels. (The Mexican saying for this is "Do more with less").
- Improve competence between service providers to bring down cost, and promote public-private alliances.
- Enhance coordination between federal and local authorities.
- Support local authorities to continuously make needs assessment and cost benefit analysis.

3.1.4. Bandwidth as state policy.

As an example of processes to be handled in favor of the disadvantaged, connectivity is becoming one key factor, particularly via Telecommunications. This however poses a difficult question about the balance between investment and technical specifications. The case of Mexico demands attention as major programs are devoted to extend connectivity and reduce the isolation of poor communities. Reaching most of them became a real, in the largest true challenge of investment ever made. But on the other side, speed and bandwidth specifications can become tight in the near future. Once infrastructure is put in place, an almost irreversible effect is created which, is why extreme attention is required; up to the point that bandwidth should be considered a matter of State policy.

3.2. Human development.

3.2.1. Reinvent Profile and promoters development.

Beyond providing equipment, physical spaces, infrastructure, connectivity, and networking, what becomes fundamental is the professional development for community teachers and promoters as mile-

stones of all learning change processes. The fundamental goal for any project directed to a permanent development of teachers and facilitators cannot simply be the provision of telematic resources.

Beyond that, this challenge requires serious consideration on which telematic tools give opening to a new context for the use of information, and bring new opportunities for skill development.

The challenges outside are so special, that the call is for a real reinvention, under a quite different profile of the task and mission for any facilitator, teacher or promoter linked to assist disadvantaged communities. As a matter of fact, a combination of roles, formerly separate is required. Latin America has worked for many years with community promoters, looking for internal leadership that helps introduce change and new development goals. In a way, they teach, but mainly they assist people doing things in new ways. On the other side, most teachers are prepared to work under schooling formats, and when dealing with disadvantaged communities, a whole new approach is required.

New curricula is on demand precisely for the development of this new kind of facilitator, simultaneously composed of a promoter and a teacher. New tools are to be used, new content and completely different methods. Not an easy endeavor, where a whole reinvention process has to be put in place if a real success is to be obtained with ICT participation to help the disadvantaged to overcome the situation.

3.2.2. National Pedagogical University – Inspiring Role.

Human development goals concerning the introduction of ICT is clearly critical. In Mexico, for instance, the National Pedagogical University (UPN) has played for years a respectful role inspiring models in a close association with communities. BICAP and Mazatlan models are rich in a delicate balance promoting adoption of high level ICT tools, and enhancing identity and diversity. UPN basically promotes better knowledge between them and the different models achieved. Three major driving forces shape the UPN action in the field: interculturality, diversity, and “indigenous ”.

Yet by 1981, UPN established for the first time a professional degree career for teachers devoted to indigenous an education. This great effort rendered intellectual capital for pre-school and elementary education profession. Today, UPN proudly offers a master’s degree on indigenous education. It is worth mentioning, that learning has been a two sided construction of a fundamental knowledge body, based on reality and respect, which is quite valuable for any kind of intervention.

Of course, the university offers an important array of curricular approaches and several degree programs in almost any area of education, managing a large population of students in 76 campuses countrywide. Large programs are set forth to serve basic functions like academic international and regional interchange, editorial and printing tasks, Libraries, promotion and public communication. Research and consulting. A videoconference high speed link and several campuses with a fiber optic computers network are the initial stages to strengthen the incorporation of ICT into the current development plan.

3.3. Europe-America collaboration.

Education has always been an international process by nature, despite the fact that every country applies local personality and content. Learning is today a common endeavor for humanity. Using ICT for the benefit of learning opportunities for the disadvantaged demands a lot of collaboration, ranging form international technical and financial cooperation, to academic modeling and experiences interchange. Under the frame of OECD cooperation between Latin American countries and European Union, one may easily reach many dimensions, particularly in the case of Mexico. From those dimensions, immediate collaborative actions are recommended in view of the disadvantaged. Three of them are illustrative:

3.3.1. Joint studies.

It is enough to mention that since its creation, OECD brought about a great contribution with CERI, the Center for Educational Research and Innovation. A valuable resource supporting the new vision for issues like ICT and Learning, for national policy analysis at member states, or the studies on issues covering a wide spectrum from brain research results to e-learning, from schooling of tomorrow to adult learning, from finance and economics to digital divide.

National policy analysis made for several countries and many other studies can easily be extended to countries in Latin America and Mexico, under Joint study arrangements. Surely, a valuable international service.

3.3.2. Evaluation tools

When a paradigm shift is applied, and if it is mainly a result of the introduction of ICT, one of the hardest problems is to find, apply and observe, evaluation and follow-up processes. If evaluation of learning is difficult, the design of new tools to evaluate a new paradigm is even more.

The OECD Program for International Students assessment is a powerful example on how important can a tool become under multilateral collaboration. PISA served as a route indicator to formally approach the new paradigm.

Under supervision of ILCE and UPN, Mexico is about to apply the third stage of the research tool for a "Quasi-experimental study" on ICT skills and concepts, and on Concepts and Skills on Information Management. During the academic periods of 2000-2001 and 2001-2002 the two previous phases were carried out with the participation of 12 states, 33 schools, more than 2,800 third grade students and 720 teachers. With no doubt, this international tool enabled Mexican authorities to view, for the first time, what is happening at the schools that recently entered into ICT based programs. The point to note here is the extent and the potential that Europe-America Collaboration can reach for the future, particularly providing insight and vision to reinvent the learning offer for the disadvantaged.

3.3.3. Policy design.

After dedicated study and consideration, manifestations emerging from the European Union Education Ministers are becoming a lighthouse for other countries now involved in processes like ICT incorporation to education. Conclusions from the debates, with deep research behind, are collected in publications like Education Policy Analysis, which surely can be taken as landmarks on the way to better understand the new paradigm.

Great wealth can be expected from joint projects between European Union and Latin American countries in terms of policy design, then helping reduce the global imbalances observed, but mainly to shape a national policy for a particular nation that can compare itself against others.

3.4. Learning communities on ICT and Learning for focus groups.

A final recommendation. A lot has still to be learned about ICT and its applications, particularly for educational e-Learning environments, with further and deeper exploration. Even more has still to be learned about Inequality and communities. A major endeavor, joining forces everywhere is urgent-

ly required if authorities don't want to fail accomplishing the paradigm shift to reinvent the offering for an ICT assisted learning opportunities for the disadvantaged.

3.4.1. Exploration and learning about ICT and applications.

Will the recently announced WiFi technology help liberate communities from the costly telecommunication infrastructure and tariffs, and from excessive regulation, as it is claimed today?. Under wireless application programs and devices, can the handicapped increase their independence?. As it was said, answers to these and many other questions urgently demand further exploration, and deeper learning.

No nation can afford to face this alone. Multilateral collaboration is mandatory, under blueprints that are still to be agreed. For decision makers and educators as well, this can be a last call.

3.4.2. Exploration and learning about inequality status.

When the word *community* is said, is the meaning the same as it used to be, after the introduction of ICT and learning?. The notion of *collaboration* remains the same when interacting via a network in Cyberspace?. Digital divide, and Inequality are at the same time demanding concepts looking for deeper understanding.

Mexico has been gaining great learning with the initiatives that bring ICT to the processes approaching for example, indigenous communities Lessons that needs to be shared and aggregated to the international body of knowledge about Indigenous learning. Research and experience in this subject, aside from being expensive, demands talented people, experienced methods and long term projects. International long term, focused collaboration is nothing but a must here.

3.5. Challenges ahead.

UNESCO has repeatedly summoned the world by pointing out the challenges ahead. Jomtiem and Dakar World Summits on education, depict the scenario. That is why a note deserves attention: " To engage in a dialectical process of developing and implementing new visions, learning seeks to connect dynamic partners throughout the world (ranging from governments, NGOs, private companies, donor agencies, universities, foundations, etc.) and to initiate on-going dialogue, critical reflection and creative action with them around diverse inter-connected themes, such as local knowledge systems, mind/brain research, complex adaptive systems, social equity, mediated environments, organizational learning. The action and reflection undertaken by its partners ultimately defines what learning is and what it will become".

Again, from a Mexican Local view; The philosophical approach that has guided the actions described for the aforementioned project at Santa Maria Tlahuitoltepec in Oaxcaca State, Mexico, can be easily extended as a general vision when dealing with communities at disadvantage: "To construct an integral development of their culture by means of Learning, where the Philosophy, the History, the Literature, enter into a renaissance stage and flourish .

"Every intervention needs to be a learning project, in harmony with the people's cosmogony where care is taken for customary approach and tradition, language, and culture, giving priority and recognition to their status of being a indigenous community, to their developmental needs, and at the same time, seeking for their integration to local, regional, national and global environments". (BICAP, 2001)

"What distinguishes the poor - be them people or countries -
from the rich is not only that the poor have less capital,
but also less knowledge"

Important links on ICT in education in Mexico

http://redescolar.ilce.edu.mx	México Schoolnet
www.sepiensa.org.mx	Secretary Education portal for children
www.conevyt.org.mx	Community plazas portal
http://www.e-mexico.gob.mx/wbz	e-mexico National Initiative

REFERENCES

THE WORD BANK GROUP. (2003)
Poverty Net, Poverty Reduction Strategies – Washington, D.C.
http://www.worldbank.org/poverty/index.htm

UNDP. (2001),
Human Development Report. Making New Technologies Work for Human Development. New York.
http://hdr.undp.org/reports/global/2001/en/

GIUGALE, MARCELO M, LAFORCADE OLIVER AND NGUYEN VINH H. (2001)
Mexico: A Comprehensive Development Agenda for the New Era. The World Bank, Washington, D.C.

KELLEY, G. (2001)
Different Educational Inequalities: ICT an Option to Close the Gaps In: *"OECD Learning Inequalities Roundtable".* ILCE-SEP (Mexico).

DEVELOPMENT GATEWAY. (2003)
Indigenous Knowledge, Gender and Development. Washinton, D.C.
http://www.developmentgateway.org/node/130646/
http://www.developmentgateway.org/node/130625/

MATSUURA, KOICHIRO. (2003),
Introduction, Expert Meeting on the service of persons with disabilities. Unesco, (Paris). Unesco Director General.

THE WORLD BANK.
World Development Report 1998 / 1999: *Knowledge for Development* Washington: Oxford University Press.
http://publications.worldbank.org/ecommerce/catalog/product?item_id=217020

LEARNING DEVELOPMENT INSTITUTE. (2003),
Learning Without Fronters – Task force. LDI – Delaware, USA, Unesco: Connection Paris and State University of Florida, USA

UNESCO. (2003),
The Learning Without Fronters Connection. Paris: United Nations
http://unesdoc.unesco.org/images/0013/001303/130314e.pdf

SEDESOL. (2003)
Jovenes con Oportunidades. Mexico Secretaria de Desarrollo Social, the CCA TEC de Monterrey – Sedesol Project. http://www.sedesol.gob.mx/programmeas/indigenas.htm

BICAP. LA VOZ Y LA PALABRA DEL PUEBLO AYUUJK. (2001)
BICAP UPN Press: Mexico

TRAVELLERS IN CYBERSPACE: ICT IN HUNGARIAN ROMANI (GYPSY) SCHOOLS

Andrea Kárpáti

UNESCO Centre for ICT in Education, Eötvös University,
Faculty of Sciences, Budapest, Hungary

Computerisation of Hungarian education and the equity issue

The eve of the school computerisation campaign in Hungary, 1990-98, was characterized by massive investments in infrastructure. In the second phase, 1998-2001, the in-service training of teachers in basic ICT skills and discipline-based methodology of educational computing seemed to be most important. From 2002, policy makers refocused the reform movement and initiated the development of educationally valuable content and teaching methods to make best use of infrastructure and teacher competence and providing equal access to ICT culture for those with social, physical or mental handicaps. (Cf. Kárpáti, 2003a for an overview.)

In the third phase of computerization of Hungarian schools, starting in 2002, content development and diffusion of ICT-based teaching methods has become central for national sponsoring efforts. Research on student and teacher competence shows that *ICT skills are not age-specific* – even middle-aged teachers of humanities can be successfully trained for computer use. (Passey and Samways, 1997) Training efforts in Hungary are now geared towards medium and small size schools situated in small towns and villages where educational institutions may act as mediators of Knowledge Society culture also to adult citizens in their neighbourhood.

These measures are much needed, for in our country, ICT culture progresses slower than desirable. In 2002, only 10 % of Hungarians possessed a PC while in the US, more than 60 %, and in Denmark, Sweden, The Republic of Korea and Switzerland, 55-58 % of citizens could use a computer in their homes. In the European Union, Internet penetration in the homes was 40 %, while in Hungary only 16 % . The most worrying aspect, however, is the *difference in ICT penetration patterns* of the countries that play a leading role in computing and Hungary. In Sweden, for example, high level employees and blue-collar workers use computers almost to an equal extent, while in Hungary, PC and Internet use is closely connected to the level of education. These data clearly indicate that the Digital Divide is yet another extension of the already existing educational – cultural division of society.

Fortunately, Internet access in schools shows much better results for us: equal to the EU standard, 100 % of Hungarian secondary schools are connected. (Moreover, in Hungary, the Ministry of Education pays connection charges as well as telephone or ADSL bills.) In primary schools, the situ-

ation is not as good but by far not hopeless: 91-100 % of primary educational institutions of EU member countries are connected to the Internet, while 30 % of their Hungarian counterparts can use this service. (Here again, our Ministry of Education pays all charges.) If we compare the most frequently quoted figures, the computer per students ratios, in 2002 it showed rather discouraging results: 30 students per PC in Hungary, 9-12 in the EU. (Magyar, 2003) In order to increase the use of ICT in education, access to computers and Internet connectivity has to be secured for a far wider layer of the Hungarian population.

Equity issues are central, as emphasized in the Introduction to this book, written by Bálint Magyar, the Hungarian Minister of Education. The "Schoolnet Express" project: tax deductible purchase of computers for educators and parents raising school-age children, cheaper and more accessible Internet connection even from remote areas, free in-service training programs and an open database of digital teaching materials suited to our National Core Curriculum hosted and edited by our national "Schoolnet" office, *Sulinet* (www.sulinet.hu) all serve the purpose of bridging the digital gap for teachers and students as swiftly as possible.

CERI, the educational research institute of the Organisation of Economic Co-operation and Development (OECD), commissioned an extensive study to investigate if and how information and communication technologies (ICT) resulted in changes in the quality of teaching and learning in public education. The research project entitled "*ICT and the Quality of Learning*" (1999-2001) involved researchers from 23 OECD member and allied countries. As part of the project, *school based case studies* were executed that evaluated the functioning of schools incorporating ICT in their education, internal and external communication and management. Altogether 91 cases were documented in 23 countries to verify five *pairs of hypotheses* through 3-6 school studies per country The anthropological / qualitative approach included structured interviews, observation of teaching and extracurricular activities, analysis of students' ICT-related work. Schools were revisited after 6, 12 and 18 months to see how educational change due to the introduction of ICT culture prevailed. (Cf. Venezky and Davis, 2001, Venezky and Kárpáti Eds., 2004)

Extensive studies of small Hungarian village schools indicated, that ICT was perhaps the most effective device for schools situated in socially disadvantaged settlements that needed to make the "tiger's leap" and overcome decades of underdevelopment through one single investment. (Fehér, 2000) No other educational toolkit can so flexibly be adopted to local needs, no other set of information is so easily extendable. During the student and parent surveys of the OECD project, *"ICT and the Quality of Leaning",* and other international evaluation efforts, we also noticed how popular ICT was even among the most disadvantaged youth groups whose parents made huge efforts to facilitate their children's involvement in a culture they hoped would help them fight poverty and achieve a social status much higher than their own. (MONITOR, 2000) Therefore, in 2002, Hungarian researchers suggested increased government support for small and medium size schools in villages and towns with modest cultural facilities to engage in computerization and staff training. It was generally assumed that ICT tools would help develop learning to learn skills and cognitive abilities of children with social handicaps more effectively because of their inherent motivational value.

Rationale For Research on Promoting Equity Through ICT in Hungary

Some results of the OECD project showed different effects of ICT on education for Hungary – the only Eastern European participant – and the other OECD countries. The most conspicuous difference was the role of ICT in educational reform movements. The pair of hypotheses to reveal how com-

puterisation of schools effected modernisation outlined the following scenarios: „Technology is a strong catalyst for educational innovation and improvement, especially when the World Wide Web is involved. The rival hypothesis is that where true school-wide improvement is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the improvements also drove the application of technology to specific educational problems." (Venezky and Davis, 2001, 10)

In the OECD countries, the first hypothesis was proved to be valid. Those schools excelled in ICT-based innovations that had been outstanding in the use of up-to-date educational methods even before computers were ever installed. The summary of findings of this part of the study clearly indicated that infrastructure and student competence did not contribute to the success of the reforms as much as teacher attitudes, motivation and skills. Almost all of the school-based case studies showed that reform-oriented educational institutions with dedicated and highly trained staff were the first to engage in computer-related educational reforms. These schools were considered cutting-edge, innovative institutions before using ICT and continued to do good work through an effective and intensive use of computer technology in teaching and communication. Infrastructure was helpful and student support often needed but by far not instrumental. Most innovative efforts produced a diffusion pattern characterized by Rogers (1995) as "classic" for educational innovations.

In Hungary, however, results seemed to suggest a different pattern. Here, ICT infrastructure at schools played a decisive role in the initiation of educational reforms. Computer culture proved to be a successful catalyst of educational innovations and actually solicited change. The most popular educational paradigms in our country at the time of the first computerisation campaigns were *constructivism*, *situationism*, and *collaborative learning*. Students who had been considered passive receptors of teacher-generated information for centuries were encouraged to construct their own knowledge and engage in creative, discovery based inquiry in realistic situations in teams. (Halász, 1999, Schooling for Tomorrow, 2001) Hungarian education that had been geared towards instruction in high quality abstract knowledge needed a strong impetus – indeed *a new teaching-learning platform* – to alter classic pedagogical views and methods. We observed a *direct connection between the level of infrastructure and the innovative quality of teaching and learning* in the schools selected for the OECD study. (Kárpáti, 2003b) Though by far not practiced by all schools in Hungary, those institutions that were sufficiently equipped with ICT tools and digital teaching materials turned out to be much more motivated to upgrade their teaching culture than those who were left out of the computerization campaign. Similar results have been recently reported from France. (Pouts-Lajus et al., 2001)

Apparently, in Hungary, computers acted like *Troyan horses* – smuggling an army of new methods within the fortified walls of perhaps the most traditional public sector in Hungary: education. Technology acted as an initiator of the reforms – but was it really a catalyst? Did it significantly contribute to the maintenance of innovative ideas and teaching – learning methods? Providing means is one aspect - another issue is the role of ICT in keeping up high level, innovative education. Here, our results approached those of other OECD countries more closely. Hungarian schools that had been innovative before the introduction of computers – for example, the first bilingual secondary school (www.karinthy.hu) or the first privately owned educational institution (www.akg.hu) – made a better use of the potentials of educational computing. Another group of schools in our sample, however – the tiny village primary school named after the great Hungarian computer scientist, John von Neumann, (www.enjai.sulinet.hu) or another primary school in a small town at a developing industrial area (www.almasi.mako.hu) initiated educational reforms clearly after the introduction of computer technology, inspired by its potentials.

Therefore, we could not exclude the role of technology acting as a catalyst for better education although we agreed that a kernel innovation effort had to be present at a school to be successful in making full use of the potentials of ICT. (Kárpáti, 2002b) In order to further investigate the issue and find out *if and to what extent schools with no previous innovatory experiences could benefit from ICT as a promoter of modern educational culture* we decided to launch another set of experiments. In the first phase of our new project, reported here, we turned to those educational institutions that were left out of the first two waves of computerisation campaigns: small and medium size primary schools situated in the economically most disadvantaged areas of the country, with students of low socio-economic status (SES) who struggle with a range of learning and behaviour deficiencies. After reading nation-wide educational surveys and policy documents (e.g. MONITOR, 2000) we decided to select schools educating children of our largest and most disadvantaged minority: the *Romany (Gypsy)*. We believe that, if ICT-based education helps increase learning performance and thus promote social mobility here, it may be of help in other problem areas of Hungarian schooling.

Romani (Gypsy) Minority in Hungary – A Challenge for Education

Representing 8 percent of the population of Hungary, the Romani (Gypsy) minority is one of the most disadvantaged social groups in the country. Joblessness, low educational level and miserable living conditions in settlements at the edge of towns and villages or urban ghettoes seem to be inherited from generation to generation. The only way out of this vicious circle is accessible and efficient education. At present, however, only 3 % of Romani students graduating from primary school continue studies on secondary level. In higher education, the percentage of Romani students is minimal – about 0.22 %. Most research reports assume that bad learning performance and resulting lack of mobility is due to the effects of the home – the economical, linguistic, cultural and social handicaps that determine the fate of the young child already before entering school. (Bábosik and Rácz, 1997)

Educational policy measures seem to contribute to further segregation of the already outcast – creation of "special classes" with no specialised mentoring programme and the sole purpose of "keeping problem children out" of the group of their luckier peers. Although forbidden by law and severely punished when disclosed, several Hungarian schools still prevent Romani students from entering the same facilities that Hungarians are using. As social handicaps often lead to smaller deficiencies misinterpreted as major mental illnesses, many Gypsy students find themselves in special education classes together with young patients who actually need the treatment provided there. When unchallenged intellectually, healthy Romani students soon loose interest and actually decrease to the level of mentally handicapped. Some of these educational approaches will be detailed below.

Surveys on equality issues in education also indicate that Romani students still have little access to secondary level education and practically no access to higher level learning. Their integrative and compensatory education is a problem still unsolved, although there are increased efforts to remedy the situation. (Glatz, 1999) Generally, there are four major models used at Hungarian schools for fighting social handicaps in education (Nahalka, 2003):

1. The *conservative paradigm:* schooling should preserve traditional values for society and separate students who are unable and / or unwilling to cope
2. The *liberal paradigm:* through an equal access to educational institutions and facilities, socially conditioned differences will automatically be decreased and finally diminished.
3. The *compensatory paradigm* is based on multiculturalism and a sociological approach

to educational issues. According to it, the source of inequality in education is the socio-cultural background of families. Handicaps resulting from different patterns of family socialisation should be compensated for.

4. *The emancipatory paradigm*, based on intercultural education: differences among children are perceived as cultural characteristics that are not necessarily handicaps. Education should be based on student / community culture and not on presuppositions about how they should be.

Most frequently used strategies in Hungary include

- Placement of Romani students in *remedial groups* half the size of a traditional class. This method only helps if there is a special training programme available for these students tailored to behaviour and learning deficits. In most cases, unfortunately, only an abridged and simplified version of the "normal" curriculum is offered.
- Placement of Romani students in *classes for mentally and / or physically handicapped children* even if they do not show clear signs of suffering from either deficits. Regular checks by local educational authorities try to prevent this malpractice.
- Organisation of *Romani primary and secondary* schools that openly adopt their culture, cater for their special learning needs and promote their identity through a variety of arts programmes. Although seemingly segregationist in approach, these institutions are extremely successful also in catalysing integration of their students in the Hungarian community. These schools are open to the public with a variety of programmes and often engage in collaborative project work with Hungarian schools in their area. Students of these schools also network among themselves and build a strong and positive national identity.
- *Integrating Romani and Hungarian students* and offering individualised training for ability and interest groups. This natural arrangement would be much more popular among teachers if there were enough programmes catering for the needs of Romani students that they could adopt and tailor to the needs of their school community.

The project reported here is executed in such integrated classes and intends to promote the idea of co-operation and understanding between the majority and minority cultures. Evidently, students who are not coached or motivated at home, who cannot rely on facilities like home computer and library, whose mother tongue is not Hungarian, but one of the Romani dialects, will need remedial programmes with personalised development to cope with classmates. Differentiated instruction as well as a constructivist approach building on the treasury of practical knowledge and highly developed sensomotor skills is needed. (Nahalka, 2003) Our experiment is an effort to elaborate a *model that bridges the social divide – digitally.*

Promoting Equity Through ICT in Education: Helping Travellers Reach Cyberspace

Framework of the research project, aims and objectives

In the present OECD initiated ICT research effort, (2002-2005), coordinated by the Education Division of the organization, *equity* was chosen as one of the key issues to be investigated. In

Hungary, the Ministry of Education commissioned our research team at Eötvös University, UNESCO Centre for ICT in Education to launch our national research project in co-operation with OECD: the *Romani (Gypsy) Education Through ICT Project (2003-2005*. In the framework of this effort we create ICT-enriched, constructivist learning environments in 10 primary schools of Borsod County in Northern Hungary and develop teaching programmes for Hungarian Romani (Gypsy) children to overcome their learning handicaps and develop their national culture to its full potential. Based on results of the first OECD study outlined in this paper before that was conducted with cutting-edge schools, we now want *to show how ICT works in the most difficult educational situations*. If computer technology proves to be useful here – it deserves to be called the biggest educational invention of all times. At present, 5-8 % of Gypsy students from our experimental schools go on studying after graduation from the compulsory primary school that involves 8 grades. Those who do not continue their studies will be unskilled workers, unemployed most of the time. We hope to at least double this miserable percentage and thus increase social mobility.

Computer-supported instruction necessarily involves *changes in the local curriculum* currently practiced at our experimental schools. Fortunately, due to some special features of Hungarian public education policy, such changes are both possible and desirable. In order to understand our output-oriented educational regulation system, a brief overview of the intricate curricular regulations seems to be inevitable. As Halász formulates it in his recent analysis of Hungarian education in transition, "the change process, as experienced in Hungary, does not necessarily follow a linear pattern (as it does in North America), also, coherent outcomes may emerge from rather chaotic processes." (Halász, 2003, 55-56) In Hungary, education as well as economy has started transformation from communism to democracy well before the political changes in 1989. Decentralisation of educational administration, intentions to "catch up with the West" through modernisation of methods and content of teaching while, at the same time, restore the traditional values of pre-war education, were major aims. (Radó, 1999) *Modernisation* and "*Europeanization*" of education seem to twin concepts in this process, starting in 1990, after the first free elections won by the national conservative party, continued in 1994, when a liberal-socialist coalition came to power and promoted without major changes of direction between 1998-2002, when the conservatives were in power again.

In 1993, the Education Act replaced the detailed, mandated central curricular programs, compulsory for all state-financed educational institutions in the country, by a *two-level regulation system*. One of its key components was a *National Core Curriculum* (NCC, issued in 1995) that outlined the Hungarian educational framework through the description of output requirements in major fields of knowledge and cross-curricular areas. In the NCC, written by a group of progressive educators who capitalised on decades of research when formulating this knowledge structure, Information Technology (IT) was defined as one of the major area of knowledge and computer skills were to be developed both in the framework of a distinct school discipline (compulsory for Grades 7-11, optional from Grade 3. The second component, adapted to it was the school-level regulation of the teaching-learning process defined by *local educational programs and curricula* elaborated by school staff members and approved by local educational authorities. In the educational programs, schools developed their locally relevant strategies, considering their individual strengths and weaknesses as well as their needs and goals. (For the Romani ICT project described in this chapter, schools were selected on the basis of their willingness to embrace computer culture manifest in their educational programs but not realised because of the lack of financial means and expertise.)

The broader areas of knowledge outlined in the NCC were not always interpreted by schools correctly and national surveys showed great diversity of attainment level of students partly due to differences in local curricula. In order to secure the quality of education and assure a common knowl-

edge base for all Hungarian citizens, the 1999 Modification of Education Act added a new regulatory document to the NCC – the *Frame Curriculum* (FC). Between 1999-2000, professional teams commissioned by the Ministry of Education elaborated this central set of guidelines that was meant to provide schools with models of curricular planning. While the NC did not prescribe certain disciplines when defining outcome requirements for broad knowledge areas only, FC reintroduced them and assigned clear content models with traditional and novel disciplines attached to each area. As the number of compulsory classes was reduced in order to free school time for skills development, some disciplines – especially science and the arts – suffered severe time cuts. Fortunately, the team that elaborated the FC for Information Technology managed to strengthen the positions of the discipline, securing increased curriculum space for more grades with a more practice-oriented teaching content. As all other FC advisory groups, IT specialists also offered a national supply of curricular programmes that schools could use when elaborating their local curricula. Thus, new IT teaching models based on international research and national skills assessment spread at a formerly unimaginable speed. History of computing, a lengthy introductory part of the IT curriculum was, for example, replaced by a functional overview of hardware systems. With the appearance of sophisticated authoring systems and user-friendly office solutions, teaching programming languages lost importance and was partially substituted by user skills development.

ICT requires intensive and lengthy periods of study for mastery of even basic communication and information management skills. Personalised advice is often required, pair and group work essential. Another characteristic feature of the Hungarian educational scene of the turn of the millennium, *demographic decline* made it possible – even necessary – for schools to create more learning time for less students through forming smaller groups by dividing classes for sport, the arts, foreign languages and, - IT. Fortunately, the everyday existence of schools became more and more dependent on computer culture and, not wanting to loose specialist teachers, management increased the number of IT lessons through the creation of smaller study groups and added free time, optional sessions (e.g. basic multimedia, ECDL, Internet search) to keep the IT teachers employable. These arrangements were extremely beneficial and provided a framework for development efforts, like the Romani ICT Project, to go beyond teaching computer skills and embark on modernizing the whole educational culture of the institution.

Complex research efforts like the one described here, combining innovative curriculum design, teacher training, continuous mentoring and regular student assessment through nationally standardised tests are much needed in the present phase of educational paradigm changes in Hungary. The new types of curricular regulations represent challenges Hungarian educators are still struggling to meet. "The implementation process was (...) characterised by a number of *contradictions and paradoxes*. One of the most glaring is the fact that serious reflection about the implementation strategy of the new content-regulation system began only *after* the implementation was underway. Post-implementation discussion revealed a number of difficulties which, had they been explored during the planning phase, might have influenced decisions made by the system's designers. As it was, the challenges faced by teachers in every school and the tremendous extent of the challenges faced by teachers in every school and the tremendous need for external support became clear onléy during the process of implementation itself. (...) The whole process of change was accompanied by various kinds of *uncertainties.* Because of the novelty of many elements, teachers, principals, and other educators raised a multitude of questions that the administration was incapable of answering. During the implementation period, a myriad of technical problems also arose, ranging from deadline problems and defects in the electronic communication network, to a lack of quality control. – *Macropolitical influences* also figured prominently in the implementation process. Frequent declarations by the

opposition party that, when elected, they would significantly modify the new system caused many local administrators to feel uncertain about the outcome of the reform process and prompted them to adopt a 'wait-and-see' attitude." (Halász, 2003, 66-67)

In this excited and cautiously optimistic climate, ICT-based educational experiments seem to promise a path that is very likely to survive changes of policy as they furnish students with skills the whole society considers increasingly important. As schools are more and more "tired of change", we have to offer them improvement and stability at the same time through adapting ICT-based teaching methods to existing national and local curricula. We intend to enrich disciplines that manifest considerable difficulties for teachers of socially handicapped students with relatively easy to use visualisation, simulation and communication tools to make both teaching and learning enjoyable. We do not want to re-fashion the school, we want to show how locally relevant needs are to be met through information technology – a catalyst for reforms, as we have proved earlier. (Kárpáti, 2002b, 2003b)

Experimental sample

Situated in small villages or suburbs of towns, the group of 10 primary schools we work with struggle with a range of problems that we hope to solve or ease by the use of ICT: lack of suitable teaching aids and individualized learning toolkits, motivating communication environments, an equal access to relevant information and a well-trained and experienced in ICT use staff. The *student population* selected for ICT-enriched education are all 7th Graders of the schools, 264 students aged 13-14 years who will receive two school years (2003/2004, 2004/2005) of ICT-enriched training in five disciplines (details below). Our major aim is to enable many of them to continue their studies in secondary education to learn a vocation or prepare for higher education in a secondary grammar school. Girls and boys are almost equally represented in the sample. *Schools* all educate low SES students and the ratio of Romany (Gypsy) students is between 65-80 %. These institutions represent major primary school types of the county: the small village school with partly multi-grade classes, the school and house of culture compound, the minority education centre that provides in-service training for other primary schools in the area and the arts-oriented school with specialised classes and courses for talent development in music and the visual arts – two areas the Romani minority living in Hungary traditionally excels in.

New learning environments for schools

At the beginning of the project, May 2003, we prepared detailed case studies were made on the infrastructure, staff ICT competence and teaching practices, student achievement levels in major disciplines and ICT skills, school management methods and plans for development. Based on these studies, school principals and their staff elaborated an ICT development plan together with the technical specialists of our research team. Using funds from our research grant and applying for local and national support, we have started to create a minimal infrastructure for ICT-supported education. By the end of 2003, all schools will have had a computer laboratory with Internet connection and all participating classrooms have a PC constantly available for demonstration and practice. An Intranet has been set up in those schools with no local area network and basic software packages purchased and installed for daily use. School libraries and staff rooms received book and software packages collect-

ed for the five disciplines involved in our experimental treatment. Five schools applied for a PHARE grant to build a new computer annex to serve community as well as school purposes.

Methods of treatment

After an intensive summer course for teachers of the participating primary schools, new local curricula were developed enriched with ICT-based teaching and learning methods in the following disciplines: *Mother Tongue, Science (Physics. and Chemistry), and Mathematics*. Methods were selected to develop cognitive abilities and communication and learning to learn skills through virtual learning environments, online and CD-ROM databases and individualised tutorial and examination systems.

Isolation is one of the biggest handicaps of village schools. Minority students here feel even more excluded from national student festivals and competitions as very few of these are especially geared towards their native culture. We hope to remedy this situation through organising collaborative learning experiences and cultural events for the primary schools participating in our project through the Internet. Students of the ten partner schools are encouraged to work collaboratively on digital projects of common interest. Their first task was to invent the name and design an appropriate logo for our project. The winning team selected the Romani word *"Sityipe"* ("Open Door") and designed the Romani symbol of time and progress, the wheel in the centre of a computer screen in their favourite colours, bright red, yellow and green for a logo.

We prepare students for secondary education and individual studies with the help of *Information Technology (IT)*, a compulsory school discipline in Hungary. In our experiment, IT education focuses on fostering information retrieval, processing and presentation skills. Extracurricular activities are also offered to help increase ICT competence of 93 % of our experimental population: students who do not possess a computer at home. Through the creative use of digital communication media, we invite students and teachers to share Gypsy cultural heritage through home pages and school magazines.

In 4 of the 10 settlements, it is only the local primary school, our partner in the project, that is furnished with computers – even the Village Hall has none. Therefore, we hope to develop our experimental schools ICT knowledge centres for their settlement by the end of the second school year. We train and encourage school staff to offer basic ICT courses for adults (mainly parents, grandparents and alumni) and help the work of the local administration with computer based clerical and Internet services.

Teacher Training: the Mentoring and Role Modelling Method

Local teachers who have volunteered to participate in the experiment teach the five school disciplines that form the basis of the treatment. They have formed *discipline based ICT study circles* coordinated by *mentors*, members of our research team who are experienced teachers and ICT specialists at the same time. Three of the five mentors are currently working on their PhD dissertation connected to the project, thus they act as participating observers and facilitators at the same time. Study circles meet once a month for a weekend to discuss problems of ICT use in their discipline, share teaching results, learn and practice new methods or experiment with a new device or teaching aid.

Mentors always present samples of their own work with ICT (video documentaries, PowerPoint presentations and small programmes (for example, Java applets) they developed for educational use and share student work with their colleagues. They describe in detail, how they prepare for ICT-sup-

ported classes, what information resources they use, which tools they find most helpful for the development or adaptation of teaching aids, how much time does it take to prepare for a lesson, and how can student development be best assessed. Thus, local teachers, novices in educational computing, will not only learn methods but also a new working culture presented by an authentic role model: their peer.

Assessment of student achievement

Students were pre-tested at the end of 6th Grade, in May 2003, before experimental teaching had begun in September 2003. They will be post-tested at the end of both school years (end of 7th Grade, May 2004 and end of 8th Grade, 2005). Five areas of skills and abilities are assessed with tests developed and standardised for Hungary by the Educational Research Group at the University of Szeged, Department of Education headed by Benő Csapó.

1. General thinking abilities (Test for Inductive Thinking)
2. Operational abilities (Test for Combinative Abilities)
3. Reading achievement (Text Comprehension Test)
4. Self-regulation learning strategies and learning motivation (Learning Abilities Test)
5. Affective dimensions of personality (Personality Characteristics Test)

Testing involved 120 minutes in total and was evenly distributed between two school days. Results were computed for all students, classes and the whole experimental group. Comparative data were presented from previous samples representative for Hungary and the given age group and sub-samples including students from Hungarian schools with similarly low SES only. Teachers were furnished with a detailed documentation of results of their students and classes. Statistics were explained in detail with consequences for development. ICT-enriched curricula were elaborated after the analysis of pre-test data (June-July 2003). Curricula for the second school year (2004-2005) will be based on findings of the first post-test (May 2003) and classroom experiences of the first school year.

First results of the tests and their consequences for treatment

An encouraging result of the pre-test: all low SES classes include some students that are close to or even slightly above the national average. There is one class where all students are around the average level of achievement in all the areas tested. Apparently, social handicaps and resulting learning deficiencies are in some cases successfully overcome by efficient teaching methods.

In total, however, results are in all areas below the national average. When discussing the tests with those teachers of the schools who decided to join our experimental team and take part in the development, we found that *factors contributing to low learning results* are way beyond insufficient or inappropriate school-based treatment. One of the most important problems affecting school performance is *early socialisation*. Children as young as 10 are often asked to work after school and thus contribute to family income. This activity is often more interesting for youngsters than attending classes and leads to frequent absence. However they are asked to work, children are still pampered and considered the biggest asset of the family. Their desires are often fulfilled and thus their self-control will not be developed enough for school education. Unstructured, intensive, warm and secure

family life does not allow for a disciplined division of learning and playtime and leaves little attention to schoolwork. Free expression of emotions, frequent outbreaks of joy and sorrow are experienced from a very early age and lead to the lack of emotional control or to expressions intolerable by the Hungarian majority.

Adolescence is an age almost totally absent from the life of Gypsy children. Students aged 13-14, are treated by their families like "little adults". They have the right to stay out all night, to engage in live-in relationships and eventually also bear children who will be brought up by their grandparents together with their young mothers and fathers who in turn have to contribute to housework and paid work more and more. Thus, many of the teenagers face adult life problems. Therefore, they tend not to take school problems seriously and cannot be educated easily through praise or punishment. They are very creative in solving problems related to everyday life but have no desire to learn "abstract" knowledge and consider most learning materials irrelevant for their future. Fortunately, ICT is an exception, Romani youth finds it both intriguing and highly prestigious. One of the aims of our experiment is to show how computer culture is embedded in science and arts, how it requires interdisciplinary learning and how it facilitates knowledge acquisition and communication.

Students in our experimental schools are poorest in *inductive thinking* (average test result: 22,89 %) – a fact that hints on poor learning abilities. 9 out of 10 classes are well below the national average, one is slightly above that level. Three areas of inductive thinking were tested: number analogies (pairing numbers based on analogies represented by a sample pair), verbal analogies (selecting the suitable pair for a word from among given options based on analogies observed in the sample pair representing, for example, part and whole or cause and result relationships, synonyms, opposites, functional similarities etc.), and number sequences (continuation of a series of numbers having realised the rule of sequence building). This latter task turned out to be the most difficult one for our students. We observed significant relationship between the educational level of parents and results in the inductive thinking test. Here, education must have a social remedial function.

Students in our sample performed best in the *Combinative Thinking* Test (55,23 %) – a collection of tasks requiring manipulation with non-verbal information only. Further investigations will prove if the medium of tasks positively effected test results, but relatively good performance in handling visually transmitted information is a skill we must build our developmental programs on. Previous investigations of the drawing abilities of Romani children also indicated a high level of visual skills and abilities. (Kárpáti, 1984) This result shows that *visualisation of information* is requested for better knowledge acquisition through an intensive use of still and moving images, demonstrations and simulations. Fortunately, this function is offered by digital teaching materials in high quality. From among the disciplines included in our developmental treatment, we have remodelled local curricula for Physics and Chemistry using 60 % more visual materials than before. In mathematics, areas of geometry are interactively visualised through the use of computer-assisted design software.

Most national surveys reveal that *reading and writing performance* is central for success at school. About two-third of the Romani living in Hungary are *Romungro* (Gypsies with Hungarian as mother tongue) one third speaks a Romani dialect (*Olah* or *Beash*). Although more and more gypsies decide to speak Hungarian only, they still constitute the biggest linguistic minority in our country. Those Olah und Beash Gypsy children who did not attend kindergarten come to school without a proper knowledge of Hungarian and have grave difficulties understanding the teacher. The role of the school is, in the first place, linguistic socialisation. However, there should be an equally valid, opposing educational objective as well. In order to retain their culture, the Romani must retain their language as well – so, Gypsy minority councils all over the country organise "language and culture" courses for Romungro. In our sample, more than 80 % of Romani students have Hungarian as their mother

tongue. The others have acquired the language long before reaching 7th Grade, the start of our experiment. Therefore, *the language problem we face is that of cultural differences*. Communication patterns of Romani families differ from those of Hungarians and school education seems to prefer the latter. *Access to books and magazines* are different because of differences in financial status – most Romani families are either unemployed or do unskilled work with little regular income.

The detailed *text comprehension test* in our survey included a text comprehension task, selection from among correct and incorrect statements concerning the content of the text, finding words in the text to complete statements related to information given there, putting parts of the text in the correct time sequence, writing a summary and finding adjectives that best characterise major figures in the story. Results in this test were again deeply below the national average (47,81 5 versus 60, 69 %). We found no significant connections between the educational level of parents and reading comprehension – a result that shows the overall importance of education in this area. Digital communication through e-mail and chat facilities is a highly prestigious activity among disadvantaged youth so we build our language development strategies during Mother Tongue and Hungarian Literature studies on mentored, e-mail based collaborative projects, creation of digital texts and images on topics relevant for teenagers and information retrieval and processing activities using popular youth web sites as well as educational portals. In the second school year, we intend to include Art Education (creative arts and art history) in the group of disciplines taught with the help of ICT in order to combine visual creation with descriptive and reflective activities.

The dominant *learning strategy* for our students is memorisation (58,50 %). Other strategies included in our test were elaboration, monitoring, controlled acquisition of knowledge, attention during the learning process, and economy of scheduling. We found that self-regulatory ways of knowledge acquisition were less developed, in fact, unknown for most our sample. *Learning to learn*, therefore, has to be part of all disciplines during the project. Discipline-specific methods of information retrieval, processing and presentation should be modelled and practiced intensively as these skills seem to be key success factors for socially disadvantaged youth receiving no support for studies in the home. Learning deficits will be individually revealed, remedied and continually monitored as class masters and mistresses keep *diaries* on their students' cognitive development.

The *attention level* during learning is low (39,10 %) for a significant part of pur sample – a result that hinders effective knowledge acquisition and use. Already the first encounters with digital teaching materials, however, have shown large increase in attention intensity and much longer time spent on intensive, personalised practice. Therefore, we hope that regular, computer-supported practicing sessions included in the program of all the five ICT-enriched disciplines will result in more attentive learning.

The level of *motivation* among students in the experiment is average (55 %) This result is very promising as it is much higher than reported by other Romani studies. (Nagy, 2002) We measured intrinsic and extrinsic motivation, belief in self and learning anxiety and found that intrinsic motivation is strongest (67,46 %) and extrinsic is weakest (47,59 %). Apparently, the willingness to learn seems to be there, thus poor learning results may be explained by inadequate methods and insufficient practice due to the necessity to help parents sustain the family through work after school.

Romani children suffer from social adaptability difficulties in educational institutions, therefore success at school is also dependent on *personality traits*. Our personality tests measured energy (including features of extroversion: dynamism and dominance), friendliness (cooperation, empathy and politeness), emotional stability (emotional and impulsive control, task orientation and openness (to new experiences and other cultures). Results revealed a relatively high level of emotional stability but a comparatively low level of task orientation, thoroughness and reliability. Friendliness is a fea-

ture that does not characterise our students who are also not interested in other cultures and new experiences – features and must be challenged in the course of collaborative internet-based projects. We found no correlation between personality traits and school achievement but plans about future studies or work as well as expectations about the future are highly dependent on the above-mentioned characteristics. If we want to encourage and help our students continue their studies after primary school and thus avoid unemployment and poverty – the usual fate of Romani families living in villages – we have to educate not just teach, influencing the whole personality through shaping the mind. It is a *Knowledge Society lifestyle* we transmit through ICT culture and the success of the project ultimately depends on how tempting this lifestyle is for our students.

Large differences of results within one class indicated the need for *differentiated development* – a time-consuming and therefore rarely practised method for teachers that is, however, excellently supported by most up-to-date digital teaching aids. The general level of abilities does not, however, explain extremely poor learning results. These students are certainly capable of learning much more and achieve higher marks leading to better average results – necessary for secondary school entrance – if their learning methods were improved and their knowledge processing strategies more diversified. Also, language skills are in need of further development. Most Romani children in our sample spoke Hungarian fluently by the time they enter primary school and use their mother tongue (a dialect of the Romani language) only at home, in conversation with elderly relatives. Still, both oral and written comprehension is poor and insufficient for efficient learning. Therefore, we focus our development efforts on teaching how to learn (methods geared towards a better understanding of Mathematics and Science are especially needed) and developing communication skills through digital platforms.

Teachers have entered the project with absolutely no ICT knowledge (78 %), a medium level competency (12 %) and a diploma or certificate in ICT (10 %). After the summer course, the majority of novices asked for a supported European Computer Driver's Licence (ECDL) training course and are now preparing for their examination. Parallel with basic technology training, all teachers of the five selected disciplines attend monthly mentoring weekends and make more and more use of ICT-supported pedagogical knowledge, as they feel more competent in basic skills.

School principals unanimously agree that ICT-enriched education may be the chance of a lifetime for their students and support their staff members in their re-training efforts. Still, it is extremely difficult for participating teachers to learn about new educational technology and a new philosophy and practice of teaching at the same time. Several teachers complain about intellectual or emotional overburden but none has left the project so far. In fact, village intellectuals seem to welcome the chance of adherence to a larger professional community and enjoy the team spirit. Gypsies in Hungary are no "Travellers" in the sense of their natives living in other parts of Europe. They settled in Hungary centuries ago, in many consecutive waves, but they still seem to have a long way to go until they fully realise their potential. Helping them do this journey through cíberspace and real spaces is the mission of our experiment.

The research team encounters problems not usually present at educational development projects: the need to act as a social worker trying to raise funds, member of an ICT technical helpdesk always ready to mend faulty machines, a moral supporter (a shoulder to cry on) available constantly by e-mail and phone and a guide plus role model in modern education. The thrill of breaking new ground through helping the most needy and the challenge of contributing to the solution of one of the biggest problems of Hungarian education: social immobility and unequal access to knowledge makes this project a unique experience.

REFERENCES

BÁBOSIK, ISTVÁN, RÁCZ, SÁNDOR EDS. (1999)
Romapedagógia. (Ronai education). In Hungarioan. Budapest: Eötvös University, Institute of Education and Pro Educatione Gentis Foundation

FEHÉR, PÉTER (2000)
The Road Less Travelled: ICT Culture of Hungarian Village Schools. *Ninth EARLI Conference*, Friburg: Switzerland. On-line copy:
http://www.mek.iif.hu/porta/szint/tarsad/pedagog/infoktat/road

GLATZ, FERENC ED. (1999)
A cigányok Magyarországon. (Gypsies in Hungary). In Hungarian. Budapest: Hungarian Academy of Sciences

HALÁSZ, GÁBOR ED.(1999)
Report on Hungarian Public Education. Budapest: National Institute for Public Education.

HALÁSZ, GÁBOR (2003)
Educational Change and Social Transition in Hungary. In: Anchan. J.P., Fullan, M., Polyzoi, E. (ed.) *Change forces in Post-Communist Eastern Europe*. Routledge-Falmer. London and New York. Pp. 55-73.

MAGYAR, BÁLINT (2003)
The e-Learner in 2010. In: *Government Leaders' Forum 2003,* Rome: Microsoft. A CD-ROM publication. Printed version: Budapest: Hungarian Ministry of Education.

KÁRPÁTI, ANDREA (1984)
Same Land - Two Worlds. Contrastive Analysis of Gipsy Children's Drawings. In: Allison, Brian and Mason, Rachel Eds.: *Environmental Consciousness in Art Education*. UNESCO, Paris, 1984, 64-70.

KÁRPÁTI, ANDREA (2000)
ICT in Hungarian Education: Who / What is inside the Trojan Horse of Education? *International Journal of Educational Theory, Research And Practice,* 2, 23-30.

KÁRPÁTI, ANDREA (2002A)
ICT Culture in Hungarian Schools – results of the OECD Study from a Central European Perspective. *IFIP SEC III Conference*, Abstracts, Dortmund: University of Dortmund, (CD-ROM publication)

KÁRPÁTI, ANDREA (2002B)
Report on the Hungarian Case Studies of the EMILE Project. (Full English online version available at the project web site: www.emile.eu.org)

KÁRPÁTI, ANDREA (2003A)
ICT in Hungarian public education – An Overview. *Journal of Educational Multimedia and Hypermedia,* accepted for publication in May, 2003.

KÁRPÁTI, ANDREA (2003B)
ICT and the Quality Of Learning at Hungarian Schools - Results of the OECD Study In: Dowling, Carolyn, Lai, Kwok-Wing Eds. (2003): *Information and Communication Technology and the Teacher of the Future.* Kluwer Academic Publishers: Boston, Dordrecht, London, pp. 235-246

MONITOR 1999 (2000)
Evaluation of Educational Achievement. Budapest: National Institute for Public Education. In Hungarian.

NAGY, MÁRIA (2002)
Cigány tanulók az iskolában – a tanárok beszélnek. (Gypsy Students At School – Teachers Talk. In Hungarian. *Magyar Pedagógia,* 102/3, pp. 301-331
Schooling for Tomorrow (2001). Learning to Change – ICT in Schools. OECD: Paris.

NAHALKA, ISTVÁN (2003)
A roma gyermekek iskolai nevelésének helyzete. (Education of Romani Children at Hungarian Schools). In. Hungarian. Budapest: Eötvös University, Research group for gypsy Studies

PASSEY, D., SAMWAYS, B. ED. (1997)
Information Technology: Supporting Change Through Teacher Education. London: Chapman and Hall.

RADÓ, PÉTER (1999)
Transition in Education. The Key Education Policy Areas in the Central European and Baltic Countries. Budapest: Institute for Education Policy, Open Society Institute

ROGERS, EVERETT (1995).
Diffusion of innovations. New York: Free Press

POUTS-LAJUS, SERGE, RICHÉ-MAGNIER, MARIELLE (2001)
New educational technologies, an opportunity to rethink educational relationships. Online version at http://www.ote.fr.

VENEZKY, RICHARD AND DAVIS, CASSANDRA (2001)
Quo Vademus? The Transformation of Schooling in a Networked World. Draft Executive

Summary of the OECD project, "ICT and the Quality of Learning". Paris: OECD. Unpublished manuscript.

VENEZKY, RICHARD AND KÁRPÁTI, ANDREA EDS. (2004)
Case Studies on ICT and Educational Change – Issues from the OECD Project ICT and the Quality of Learning. A special Issue of ECI (Education, Communication and Information,) 2004/2

ACKNOWLEDGEMENTS

Grants for this project are secured by the Hungarian Ministry of Education. Student skills assessment is undertaken in co-operation with the Educational Research Group of the Department of Education at Szeged University. (Diector: Prof. Beno Csapó, research consultant for our project: Éva Molnár.)

Field research is organised and developmental programmes undertaken in co-operation with the County Administration of Borsod-Abaúj-Zemplén County and the County Institute for Public Education and Educational Services. The local research team is lead by Mr. Dénes Kormos, Vice President of the County Council whose work and the devoted contribution of his team is recognised in appreciation.

INFORMATION AND COMMUNICATION TECHNOLOGY AS A KEY TOOL FOR MEETING SPECIAL EDUCATIONAL NEEDS

Amanda Watkins

European Agency for Development in Special Needs Education, Denmark

The aim of this paper is to outline some of the key issues evident in different European countries when ICT is used within special needs education (SNE) settings to support learners who, within the brief of the OECD Hungary Workshop, can be considered to be considered as at risk and/or low achievers. These learners are those with special educational needs (SEN). There is strong evidence from various countries that ICT can be a useful tool in meeting the individual learning needs of learners with SEN, but there are important factors to be considered if the use of ICT is to be effective. This paper attempts to describe these factors in relation to the experience of countries who are members of the European Agency for Development in Special Needs Education (www.european-agency.org). It will then go on to outline how key representatives from the European Agency member countries see the future of ICT in relation to meeting special educational needs. The information this paper is based upon outcomes from the European Agency ICT in SNE project which since 1999 has involved 17 European countries and has covered a number of activities and events. The information also includes data from a number of EU candidate countries (Cyprus, Poland and Slovakia included here) that participated in a Eurydice network – European Agency collaboration project during 2002.

Preamble

Before outlining some background to this paper, it is necessary to clarify the use of key terms used here. Within the remit of the OECD Workshop, the terms Low Achievers and Disadvantaged are used. Readers will already note that this paper focuses upon a group identified as having special educational needs or SEN. The question is, are these terms inter-related.

It is crucial to point out that across Europe, there is no agreed interpretation of terms such as low achievement, handicap, special need or disability (European Agency/Meijer, Soriano and Watkins, 2003). Definitions and categories of particular educational need vary across countries and what maybe considered as a registered, recognised and therefore "officially" supported special education-

al need in one country maybe considered as low achievement that does not warrant specialist educational support and input in another.

Country specific situations and systems mean that different definitions and interpretations of these terms influence subsequent educational strategies and results. As the way SEN and/or low achievement is identified differs, the subsequent educational provision to meet needs – separate, segregated systems of schooling through to full-time mainstream, inclusive schooling – also differs.

The fact that what is considered as low achievement in some countries is considered as an SEN requiring specific educational support in others, not only impacts upon the information in this paper, but should also be considered by readers in relation to all the papers in this publication.

Background to the European Agency for Development in Special Needs Education

The European Agency is an independent, self-governing European body established by the Ministries of education in its member countries to act as a platform for collaboration in the field of special needs education. The European Agency is financially and politically supported by the Ministries of Education in the European Agency member countries [1]. The European Agency is also supported by the European Institutions (European Commission and European Parliament). At all times the European Agency follows the principles laid down in the UN Standard Rules, the Salamanca Statement, the Luxembourg Charter, the Helios II Guide of Good Practices Towards Equal Opportunities for Disabled People and the EU Council Resolutions concerning "inclusive education" which are considered a major focal point for the European Agency's work – the improvement of quality in special needs education within a framework of high quality education for everyone, respecting the fact that different policies and structures exist in the participating countries.

One key area for the work of the European Agency has been within the field of ICT in SNE. The European Agency has undertaken two major projects in this area, the first being SEN-IST-NET (www.senist.net) which provides a common platform for discussion and debate via a European Network of Excellence to share knowledge between two communities: Information Society Technologies (IST) (researchers and developers working in the field of IST) and Special Educational Needs (SEN) (researchers, professionals, policy-makers, industrial enterprises and NGO's in the area of SEN). The focus of the discussions (both face to face and virtual) in the network is not only on the development of technologies, but also on the fundamental questions concerning pedagogy and technology-enabled learning.

A second project has developed over a period of three years. The ICT in SNE project (www.european-European-agency.org/ict_sen_db/index.html) has, through a network of experts in the field from each participating country, conducted a survey relating to ICT and SNE policy and practice in special education situations (inclusive and segregated) in 17 European countries developed a web database of country overview information as well as an examples of practice database.

1 . As of the beginning of 2003, the European Agency member countries are: Austria, Belgium (Flemish speaking Community), Belgium (French speaking Community), Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK. Cyprus and Poland participate as observers. More information: www.european-agency.org

The main findings from the project are presented in a summary report (European Agency/Watkins, 2001) that is available in 13 European languages from the European Agency's website.

The key issues from an SNE perspective made apparent through this project focussed upon the policies that direct the availability and use of ICT in SNE and how they are co-ordinated and implemented; the forms of support and training available in ICT for SNE teachers and how the limitations in support and training place constraints upon the introduction of new technologies into the classroom situation and the current and perceived future developments in the IST field and how they may impact on SNE.

These three issues formed the basis for a conference and seminar hosted by the Ministry for Education, Portugal and organised by the European Agency in September 2002. During the two-day meeting – opened by the Minister of Education for Portugal and closed by the Secretary of State for Education – presentations were given by representatives of the European Agency, the European Agency network of ICT in SNE experts, IST researchers, disability support group representatives, representatives of the IST business sector, ICT in education specialists and representatives of the European Commission[2]. This meeting focussed upon a consideration of future visions – or prospects – for the field within the current European context of ICT in SNE.

These key issues and future visions arising from the ICT in SNE project activities form the basis for this paper.

ICT in SNE – the current European context

The use of information and communication technology (ICT) is currently very high on the political agenda of nearly all European countries as well as the European Union itself. The European Union *eEurope Action Plan* (2000) outlines the steps that need to be taken to move into the Information Society and the central role played by education in making the Information Society a reality is clearly highlighted. The OECD study *Learning to Change: ICT in Schools* (2001) clearly shows how ICT is set to transform schools and the educational experience of pupils.

On 12 February 2001, the European Council of Education Ministers decided that work must start in three priority areas: basic skills, mathematics, science and technology and information and communications technologies (ICT). *Ensuring access to ICTs for everyone* is identified as a sub-objective under the first objective of the joint report: *Increasing the quality and effectiveness of education and training systems in the European Union.* Stress is placed upon the importance of ICT in the way all European citizens work and learn, its increasing importance in open learning environments and in virtual teaching and the flexibility that will be required as regards development of ICT-related skills. The European Commission has placed great emphasis upon the following factors: innovation, teacher and trainer education and professional development, support services and 'benchmarking'.

At the national and also European level, there is current consideration of how useful indicators (benchmarks) can be to demonstrating how valuable ICT within education is and whether it does

2 . More information about the experts participating in the meeting can be found at: www.european-European Agency.org/ict_sen_db/index.html

actually significantly contribute to the development of education across Europe. The European Commission has established an ICT Experts' Group to examine this issue and there are examples of several international projects looking at this: the SITES project is an international qualitative study of innovative pedagogical practices that use ICT (www.sitesm2.org). The goals of the EC Experts' group, SITES and similar projects all focus on comparable intentions: identify innovative pedagogical practice, provide policy related information that may be useful to decision-makers, provide teachers and other practitioners with new ideas and add to the body of research knowledge that contributes to the successful use of ICT in education.

However, within such current international initiatives, SNE has not (up to now) been considered as a specific area for ICT indicators or as an area for identifying examples of innovative practice. Similarly, within the actual work of such initiatives, ICT and SNE is rarely considered in relation to policy or research advancement. Access to appropriate ICT solutions for some pupils with special needs, their families and their teachers, is often problematic in countries. Special strategies and steps therefore need to be taken if access to appropriate ICT for all pupils is to be achieved across Europe and the potential of ICT for meeting special needs is ever to be fully investigated and then realised.

A conservative estimate would suggest that 10% of the European population has some form of disability (European Commission, 1999). Depending upon the way a child is identified and assessed in the countries of Europe, pupils with SEN make up between 2% to 18% of the school age population (European Agency/Meijer, Soriano and Watkins, 2003). Whilst provision of education for pupils with special needs varies across Europe according to different educational policies and despite differences in political standpoints and practical provision, all European Union countries are in agreement that meeting the educational needs of every individual pupil and student can be viewed as an important element of guaranteeing the quality of life of all European citizens.

In all countries, ICT is increasingly seen as a major resource for meeting individual learners' SEN, but there appears to be specific issues at the policy and practice levels that must be considered if this usage is to be really effective.

ICT and special needs education policies

ICT policies are generally a specific national level statement on principles, intentions, means, objectives and timetables relating to ICT in special needs education. Short and long-term aims of national policies on ICT in the education system dictate the infrastructure of hardware and software made available to teachers and pupils. Policies and resources also have a direct impact upon a teacher's access to training, support and information relating to ICT. The different areas of concern for national level ICT policies seem to cover five elements:

1. infrastructure (hardware, software and Internet access);
2. support for practice;
3. training;
4. co-operation/research;
5. evaluation.

Different stress and emphasis may be placed upon these different aspects. The policy arrangements for each of the countries are described in the table below.

ICT policy arrangements in European countries

Element of ICT policy	**Evident in**
General – not special needs education specific – ICT policies that include statements and objectives on the five areas	Austria, Belgium, Cyprus (under development), Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, UK
The general ICT policy includes statements of equity of educational opportunity with respect to and through the use of ICT	Belgium (Flemish Community), Denmark, Finland, Iceland, Norway, Sweden
As an element of educational policy, ICT is embodied within the school curriculum that applies to all pupils, including those with SEN	Austria, Belgium (Flemish Community), Cyprus (applies to secondary and special schools only), Czech Republic, France, Iceland, Ireland, Norway, Poland, Sweden, UK
Different bodies are responsible for policy implementation	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK
Some form of evaluation of general ICT policy is being conducted	Austria, Belgium (Flemish Community), Denmark Finland, Greece, Ireland, Netherlands, Norway, Portugal, Spain (at a regional level), Sweden, Switzerland, UK
ICT is incorporated as a particular element of national disability and SEN policy and legislation	Cyprus, Portugal, Slovakia
Policy is being implemented and evaluated via dedicated ICT projects at a national level	Czech Republic, Lithuania, Norway
Policies have a direct impact upon a teacher's access to training, support and information relating to ICT	Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK

Most countries agree that access to appropriate ICT can reduce inequalities in education and ICT can be a powerful tool in supporting educational inclusion. However, inappropriate or limited access to ICT can be seen to reinforce inequalities in education faced by some pupils including those with SEN. The digital divide that could potentially develop within countries' education systems (OECD, 2001) can be seen be particularly significant within the special needs education sector.

The contributions suggest that the role of policy-makers relating to ICT must be to:

- promote basic and specific training for teachers in the use of ICT;
- ensure adequate hardware and software infrastructure is available for all pupils;
- promote research, innovation and the exchange information and experiences;
- make the educational community and wider society aware of the benefits of ICT in special needs education.

These aims can be achieved through general or special needs education specific policies, projects or programmes.

Prospects for future ICT and special needs education policies

Within the Lisbon working group the agreed vision of future ICT in SNE policies was that *policies should be trans-sectoral* and *underpinned by the clear philosophy* of meeting individual learners' needs, promoting a school for all (as described in the Charter of Luxembourg, 1996) and promoting inclusion within all educational sectors. ICT in SNE *policies need to have phases of development:* in the short term a recognisable (separate) specific action plan/strategy/policy for ICT in SNE; in the medium term, ICT in SNE becomes part of general strategy plans; finally, in the long term, ICT or SNE is not mentioned, but is accepted as "a given" within all ICT policies.

Overall, *policies need to provide the long-term vision,* but be flexible enough to *reflect local level needs* and major initiatives in all educational sectors.

In relation to what needs to happen to make this vision a reality, it was suggested that there must be a deep and critical *process of questioning and reflection* in relation to the use of ICT in SNE, focussing upon questions such as: where are we now? How far have we come? Where do we want to go? What are others doing? What can we use? What do we have to do to achieve our goals?

This *process would need to be lead by a group* (operating at regional, national and/or European levels), recognised by Ministries, who are *representative of all sectors* and all responsible and interested parties. Such a group would have a clear *role in formulating and implementing the trans-sectoral policies* as well as have a clear responsibility for *promoting communication and exchange* between different sectors of ICT practice. Crucially, they would have responsibility for *setting and implementing time frames for policy achievements.*

It was acknowledged by the experts during the meeting that the first steps to be taken would need to be *raising awareness* in all sectors that there is a need for specific policies and responsible groups, as well as the specific awareness raising of policy makers at national level and European level to the challenges within the ICT in SNE sector.

ICT in special needs education practice

ICT is used to fulfil a range of functions in the special needs education arena. It can be used as a: teaching tool;

- learning tool;
- learning environment;
- communication tool;
- therapeutic aid;
- diagnostic aid;
- tool for administrative tasks.

In addition, the potential of ICT as individualised assistive (or adaptive) technology to meet physical, sensory or intellectual needs is enormous.

There are a variety of different possible support arrangements for ICT in special needs education in the countries: services, centres, resources and people. These are not only directed by policy, but also by existing support practices and services in the countries. The focus on the table below is upon describing the types of provision available within special educational settings.

Types of specialist ICT in special needs education support

Type of support	**Available in**
National dedicated agencies for ICT in Education	Iceland, Ireland, Norway, Sweden, Switzerland, UK
Support services that work directly with teachers and pupils within special needs education	Belgium (Flemish Community), Denmark, Sweden, UK
Specialist resource centres where teachers obtain advice, materials and information	Czech Republic, Denmark, Finland, France, Germany (some Länder), Greece, Iceland, Ireland, Lithuania, Luxembourg, Norway, Portugal, Spain, Sweden, UK
Specialist support provided by special schools	Cyprus
Specialist national and/or regional working groups	Austria, Portugal
Specialist websites and online networks	Austria, Belgium (French Community), Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK
In school support	Austria, Belgium , Cyprus (under development), Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK*

* Most countries suggested that individual schools may have named staff with special expertise acting as ICT co-ordinators, but these staff were not necessarily those with SEN expertise.

Support structures appear to be quite flexible and yet interconnected in countries, usually with a variety of options being made available to teachers. In-school support is suggested as being crucial to class teachers in their work, but this appears to be an area requiring attention. For a detailed discussion of the factors that are considered to be weaknesses and strengths (respectively) in the present systems of support in countries, please refer to European Agency/Meijer, Soriano and Watkins, 2003.

Countries highlight a range of issues that currently influence the application of ICT in the special needs education context. Each country differed in the types and emphasis placed upon the issues identified as being faced in their country, but from the information presented it is possible to identify a number of common themes where issues are evident: infrastructure (hardware, software and Internet access); links to educational theory (pedagogy); teacher level issues; and pupil level issues. The tables below relate to these different issues concerning the application of ICT in special needs education.

Infrastructure – hardware, software and Internet access

Influencing factors	**Raised by**
Access to appropriate IT resources at the school and individual pupil level: hardware, software, Internet access and funding for running costs	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Norway Portugal, Spain, Sweden, UK
Access to suitably adapted or designed hardware	Cyprus, Germany, Iceland, Norway
Access to software that meets pupils particular needs	Austria, Cyprus, Greece, Iceland, Norway, Spain, Sweden
Access to Internet material designed for pupils with different types of special needs	Cyprus, Greece, Norway, Sweden

Links with educational theory (pedagogy)

Influencing factors	**Raised by**
Developing methods on how to use ICT as a pedagogical aid in the teaching of all pupils	Cyprus, Germany, Norway, Sweden
Dissemination of information on using ICT effectively in the learning environment and good pedagogical practice	Belgium (Flemish Community), Cyprus, Iceland, Lithuania, Norway, Spain, Sweden, UK
ICT methods of use adapted to meet the requirements of an individual country's educational programme	Cyprus, Greece, Iceland
ICT provides more, or added, value to the educational experiences of pupils with special needs	Belgium (French Community), Cyprus, France, Lithuania, Spain, Sweden
ICT is used to support a particular pedagogical philosophy, i.e. a school for all	Cyprus, Sweden
ICT is made an integral part of special educational provision, where every school develops its own concepts on the best use of ICT to meet the needs of its pupils	Germany

The aim of ICT in the special needs education setting could be considered to be meeting the individual needs of pupils with SEN via *an appropriate personal technical infrastructure.* The provision of appropriate technical infrastructure requires a consideration of the key principles of learning and teaching as well as the identification of individual learning styles and approaches.

Teacher level issues

Influencing factors	**Raised by**
A satisfactory infrastructure and the availability of good quality ICT educational materials are not a guarantee of effective ICT usage in schools	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK
There are various problems associated with teachers' lack of knowledge and expertise in ICT	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK
Ensuring adequate forms of teacher training for ICT in special needs education (ITT and in-service).	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK
In all training scenarios, training should aim towards helping teachers include ICT in their daily practice and the individual education plans of pupils	Belgium (Flemish Community), Denmark, France, Germany, Sweden
There are attitudinal factors in uptake/participation in specialist in-service training and subsequent implementation of new teaching methods	Belgium (German-speaking Community), Cyprus, Denmark
The application of ICT in the process of school development and management requires attention	Belgium (Flemish Community), Cyprus, Germany
The issue of the lack of training in special needs education generally	Cyprus, Ireland
There are problems associated with access to specialist information for teachers of pupils with SEN	Austria, Belgium (French and German-speaking Communities), Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK

If ICT in the field of special needs education is to reach its potential, teachers require access to more expert knowledge and there is a need for more systematic co-operation between different professionals who support teachers working with pupils with SEN in different ways. The application of ICT in the process of school development and management will need to be carefully planned and implemented. ICT in special needs education support services must be improved, as must teaching arrangements, with teachers and other professionals given time and opportunity for collaboration, promoting guidance and professional advice as closely as possible to the workplace.

Pupil level issues

Influencing factors	**Raised by**
As concepts such as 'learning to learn', 'lifelong learning' and 'online distance education' become increasingly accepted, traditional educational methodology will need to change dramatically for all pupils and those who work with them	Austria, Belgium (Flemish Community), Cyprus, Germany, Greece, Lithuania, Luxembourg, Sweden
The provision of different forms of support is not always appropriate or comparable across regions	Greece, Iceland, Ireland, Sweden, UK
There are information presentation barriers associated with the Internet faced by pupils with special needs – both in terms of level, content and languages	Austria, Cyprus, France, Greece

Access to different forms of ICT within education is a reality for many pupils with SEN, but not for all pupils. Equality of opportunity in accessing ICT through an appropriate infrastructure, specialist support and ICT competent, experienced teachers is a goal still to be worked towards across Europe.

Prospects for future ICT and special needs education practice

In relation to necessary developments within ICT in SNE practice, the formation of regional, national and inter-national *networks to facilitate connections* between good practice and resource centres and individuals are seen as crucial. This would be supported by an *in depth analysis and description of the factors leading to good practice.* Such an analysis would lead to the development of guidelines for support structures as well as more co-ordinated information about technology resources, the creation of virtual resource centres in connection with "physical" resource centres and more possibilities for virtual and physical exchanges between all professionals in the field.

It can be argued that it is essential that *all schools have opportunities to join networks and partnership projects.* Specialist, pedagogy based ICT in SNE *training needs to be extended* coupled with *more support for school development* and change initiatives. School and service based developments should be directed by *established guidelines concerning the use of ICT as a means of supporting inclusion* and facilitating access to the curriculum.

Such a vision could only become reality if there is the *creation of virtual resource centres linked to "physical" resource centres.* Access to the enormous quantity and variety of information in the field needs to be better co-ordinated, organised and facilitated. *Teacher training* needs to cover ICT and classroom management as well as the use of ICT in the curriculum at different educational levels. School development and change needs more *specifically targeted support* with input and supervision of the work regarding ICT use in SNE and *teamwork between teachers and other professionals requires support and facilitation.* Finally, it is crucial that *all hardware and software* made available in SNE settings follows the *principles of design for all.*

The actors who need to be involved in making this vision a reality include professionals within schools, pupils and their families, support service and resource centre staff, policy makers at all lev-

els, community organisations and NGOs, but also business enterprises and researchers. All possible stakeholders in the information society need to have an input into the development of practice within the ICT in SNE field. These stakeholders would need to be involved in taking the *first steps towards establishing guidelines* concerning PC/pupil ratios where ICT acts as a real facilitator of access to the curriculum for pupils with SEN.

Stakeholders would all need to be *active in promoting team work* between teachers and other professionals to help find suitable ICT solutions for meeting individual learning needs. This would include teachers having access to "easy" to use software that follows design for all principles as well as more interactive demonstrations of products. However, within the teaching profession, there needs to be more acceptance of *teachers' own personal responsibility* for their learning and development in relation to ICT.

ICT in SNE research and development

All countries raise the issue of specifically targeted research and development in the use of ICT in SNE settings. Suggestions for potential research cover all aspects of ICT in SNE usage – policy, implementation and evaluation as well as research and development of technology:

- Research into psychological and pedagogical aspects of ICT & SNE
- Research and development into new technologies specifically designed for pupils with SEN
- Research and development projects on the actual effects of ICT in the learning process
- Research work concerning how ICT may help support the inclusion process of pupils with SEN
- Transnational projects exploring video-conferencing in particular, with email and web-based support, to ascertain the value of international communication in special education
- Systematic investigations into models of teacher training, distance training and support
- Focussed information about teachers' real needs for products
- Research into systems directly related to the educational environment and its requirements
- Curricula development using ICT (considered in both a theoretical and practical way)
- In the development of educational software, there should a clear focus upon the educational context – cultural, ethnic, philosophical and psycho-pedagogical
- Systematic evaluation of the effects of ICT in SNE policies
- A survey of initiatives and projects using the full range of opportunities for educating pupils with special needs that ICT brings. Such a survey would be of projects with truly innovative aspects.

All the suggestions in this area point towards the need for systematic, long-term collaboration, research and/or evaluation that would require the input of different groups of ICT in SNE actors and users.

Prospects for future ICT and special needs education research and development

The future of research and development within the ICT in SNE field should be focused upon learning and how to improve it. The *design and development of inclusive technology* will facilitate participation taking account of diverse user groups, their wide-ranging needs, users' roles, cultures and languages. In order for inclusive technology to be developed however, *educationalists should be active participants* in shaping research and development and there should be a facilitation of greater interaction between all actors concerned.

Developments should be seen in terms of technology, but also in terms of *information and an effective knowledge base*. All new developments – both technological and educational – should be *based on research outcomes;* basic and applied research is needed, the latter being practical and realistic and *common procedures, guidelines, evaluation criteria, standards and research policies* should be developed. There needs to be a *balance between market forces and regulations* and for this, *a multi-disciplinary approach* is required with support strategies such as communication and exchange platforms and networking of researchers (conferences and technical platforms for example) being necessary.

As a first step, *all stakeholders* whatever their level of involvement or interaction need to be involved in *the development of a much broader and applicable knowledge base.* They also need to be involved – either directly or indirectly via participatory approaches and/or experts – in the development of *widely accepted guidelines regarding inclusiveness*.

Conclusions

The Salamanca Statement (1994) states that: *regular schools with (an) inclusive orientation are the most effective means of combating discriminatory attitudes, creating welcoming communities, building an inclusive society and achieving education for all.* It goes further to state that: *we must ensure that special needs education forms part of every discussion dealing with education for all in various forums.* When ICT is being considered in relation to educational provision, then the needs of learners with SEN must be considered as a natural part of any discussion and developments.

The following issues seem to emerge as points for further consideration if ICT is to be used effectively to meet the special needs of learners. Firstly, it can be argued that there is a need for a shift in focus of ICT in special needs education policies and programmes. Previously the emphasis has been upon establishing the means (infrastructure in terms of equipment and expertise) to enable ICT to be effectively applied in special needs education settings. The information from countries suggests that the emphasis needs to be placed upon the ends – the aims and goals – of using ICT in special needs education and not just the means of that use. Such a focus would help inform debates about the development of appropriate infrastructure, but would most importantly focus attention upon why and how ICT can be most appropriately used in different educational contexts. Significantly, this shift in emphasis would help centre attention upon using ICT to learn in different contexts rather than upon just learning to use ICT in different ways. Genuine inclusion of ICT in the curriculum for pupils with SEN will only occur when the full potential of ICT as a tool for learning is understood.

Secondly, whilst provision of a basic ICT infrastructure in terms of quality hardware and software is stressed, other important issues relate to developing a clear, evidence-based rationale for using ICT in the educational context and equipping teachers with the necessary skills and feelings of competence to implement this rationale in their practice.

Thirdly, the development of theory for using ICT in SNE is seen as being potentially enhanced if there are opportunities for co-operation between different groups of actors (pupils and their families, teachers, support professionals and researchers) at national and international levels. Furthermore, the possibility of enhancing virtual co-operation with face-to-face meetings and exchanges was raised. The power of ICT as a tool for communication as well as a tool for learning is reinforced by the personal contact and exchange of SNE and ICT specialists.

Finally, whilst there is information on ICT in special needs education usage available at national and international levels, information of the correct type, format and focus does not always exist – it has yet to be created and disseminated. It is crucial that the principles of information accessibility for all apply to information yet to be generated as well as that which already exists. Clear information on the needs of pupils with SEN and their teachers as ICT users should inform technological development as well as the formation and implementation of educational policy.

The debates and deliberations regarding the future prospects of ICT within SNE that have taken place within European Agency projects give clear pointers for the future. The concept of *right of access* is crucial. Learners with SEN should have a right of access to ICT solutions that are tools to develop personal autonomy and support learning. They should also have access to ICT knowledge that is essential for participation in the information/knowledge society. They should have access to information their peers do using flexible interfaces and flexible forms of presentation.

ICT can be a wonderful tool for supporting inclusion in schools and society BUT there is potential for an increase in the digital divide that currently exists for learners in our education systems leading to increased discrimination and exclusion. The digital divide will only increase unless this right of access is seen as a principle by developers, researchers and all educators.

There is also a possible irony posed by the increased application of ICT within educational contexts. A *school for all* (as defined in the Charter of Luxembourg, 1996) has its basis in the functional integration of learners with SEN into the same educational setting as their non-SEN peers. However, the rise of the *virtual school* points towards the disassembling the physical location of schooling with learners engaging in more varied forms of educational presentation. The only way forward can be to maximise the flexibility (adaptability) of a continuum of possibilities based on using ICT to meet individual learning needs.

The use of ICT in inclusive settings could help to develop a new culture of learning in education as long as ICT developments do not exclude some learners from the thinking; the sphere of actors involved in research and development is broadened; pedagogy leads the development of technical tricks and the potential of ICT as a tool that can be *truly* adaptable and can be individualised to meet personal learning needs is maximised – for everyone.

However, the move towards genuine equity in educational opportunities for all needs to be underpinned by a sense of realism as well as a clear philosophy. This sense of realism allows us to recognise SEN (and low achievement) will always be with us. As educational standards rise, then there will always be learners who – for whatever reason – fail to reach those standards. This reality will not change in the foreseeable future.

What can change is our philosophy of how we deal with this reality. Philosophies and principles promoting truly inclusive education are not just about raising achievement levels, but are based upon the values and doctrines of equality of opportunity within the practice of accepting and catering for individual differences.

ICT is one important tool that can be used by educators to meet individual needs in order for all learners to be supported in reaching their personal potential.

A future where ICT truly promotes equal education and meets special educational needs will have to be one where the principle of *inclusive by design* is applied during the planning and formation, implementation and evaluation of ICT policies, provisions and practices and where information is *accessible to all.* The foundation for this has to be co-operation between all the different groups of ICT and SNE players.

The OECD – Hungary meeting is an excellent example of how this foundation can be built upon for all learners' benefit.

REFERENCES

EUROPEAN AGENCY FOR DEVELOPMENT IN SPECIAL NEEDS EDUCATION. EDITOR WATKINS, A. (2001)

Information and Communication Technology (ICT) in Special Needs Education (SNE), Middelfart, Denmark.

EUROPEAN AGENCY FOR DEVELOPMENT IN SPECIAL NEEDS EDUCATION. EDITORS MEIJER, C.J.W., SORIANO, V. & WATKINS, A. (2003)

Special Needs Education in Europe: Thematic Publication, Middelfart, Denmark.

EUROPEAN COMMISSION (1996)

The Charter of Luxembourg DGXXII Brussels, Belgium

EUROPEAN COMMISSION COMMUNICATION (1999)

Towards a Barrier-free Europe for People with Disabilities, a Roadmap to the Achievement of Greater Community Added Value. Brussels, Belgium

EUROPEAN COMMISSION (2000)
eEurope 2002 – An Information Society For All Prepared by the Council and the European Commission for the Feira European Council, Brussels, Belgium

EUROPEAN COMMISSION COMMUNICATION (2000)
Towards a European Research Area Brussels, Belgium

EUROPEAN COMMISSION (2002)
Follow-up of the Report on the concrete future objectives of the education and training systems DG Education & Culture, Brussels, Belgium.

EUROPEAN DISABILITY FORUM (2002)
The Madrid Declaration Brussels. European Disability Forum.

OECD (2001)
Schooling for Tomorrow Initiative – Learning to Change: ICT in Schools Paris, France

UNESCO (1994)
*World Conference on Special Needs Education: Access and Quality S*alamanca: UNESCO

Information and Communication Technology (ICT) in Special Needs Education (SNE) project web database:

http://www.european-agency.org/ict_sen_db/index.html
SEN-IST-Net: www.senist.net
EC, DG Education and Culture: http://europa.eu.int/comm/dgs/education_culture/index_en.htm

CONCLUSION

ICT IN EDUCATION POLICIES: SOME HOPE FOR EQUITY

Beatriz Pont
OECD

The main purpose of the international workshop on "Promoting Equity Through ICT in Education: Projects, Problems, Prospects" was to discuss and analyse how ICT can help the lowest educational achievers to improve their school performance. Bringing together researchers, policy makers and practitioners from different parts of the world with experience in policy and practice can contribute to improved knowledge on the use of ICT for education, especially for low achievers and disadvantaged youth. Based on the roundtable discussions, this concluding chapter presents some findings on the benefits that ICT has to offer in improving low achievement in education, that may be useful for policy makers.

It is clear that ICT has a role to play in improving the situation of low achievers at school. The evidence presented by speakers and country representatives, and discussions held during the workshop reveal first, that ICT in the school may contribute to reducing inequalities by improving access to it for those who do not have it at home and second, that there are important motivational aspects for low achievers. These are common trends across countries. There is still a lot of work to be done however: research; investments in infrastructure; teacher development; and computer use. Countries have a diverse range of policies for the use of ICT in schools, but within these policies there is no homogeneity on the question of who low achievers are, on whether they should be specially targeted, on whether there should be equal access for all, or on what the best approaches are to the use of ICT in classrooms or at home. The key question that is still unclear is whether ICT directly improves performance.

ICT in its different varieties has a range of positive aspects from which schooling can greatly benefit. There are many different experiences: from Canada to Mexico, from Finland to Hungary or Korea. In all of these countries there are examples of a wide range of policies and programmes geared to ICT use at school: this volume highlights many of them. Among other uses it may be used: to facilitate learning; to provide information; to stimulate participation; and to assist with what has been called "e-inclusion". ICT is breaking down walls and barriers in communities. And governments have a role to play, especially in terms of improving equity. There are many different initiatives from indi-

vidual schools or communities, but not enough information or sharing of knowledge about what is working. It is also important not to focus on single subjects, but on holistic approaches or solutions.

Below are a set of key issues, drawing upon examples from countries that participated in the workshop, that can help to further develop policy makers' thinking on the key subject of: equity and education. Given past growth in expenditure on ICT in schools, and difficulties in obtaining or seeing the benefits from this expenditure, a number of key questions and issues need to be clarified. These include: how low achievers are to be defined; how improved performance by low achievers should be measured; shifting the focus towards teachers; improving leadership; and adopting a more holistic policy approach. Increased research on past experiences and potential benefits, and sharing this across regions and across countries, can result in a win-win situation.

1. Low achievement or disadvantaged youth? The concepts

The concept of low achievement has been greatly debated but there is no consensus on a definition. There are different ways of defining what low achievement is and different ways of measuring it. Furthermore, how it is defined can have a great impact of the types of policies adopted by governments to improve it.

The articles presented in this volume illustrate the diverse range of approaches towards the definition of low achievement. Different international assessments analysed by Hans Pelgrum show that there is an important definitional issue in describing what low achievement is (Pelgrum, 2004)[1]. Is it measured according to performance within countries or across countries? It may be an absolute or a relative concept. It can also be a quantitative or a qualitative measure. Sweet and Meates (2004) provide two definitions using the Programme for International Student Assessment (PISA) data. The first of these definitions is an absolute one, and treats those students who scored at literacy Level 1 or below as low achievers. The other is a relative measure, treating those who fell in the bottom quartile of each country's performance, whatever their absolute level of achievement, as low achievers. They present results related to ICT use and achievement for 32 countries using only the first of these two definitions.

Some researchers consider that social inclusion should be viewed as the broader theme and achievement should be a sub theme. They argue that the problem of establishing narrow definitions in order to be able to use results from international tests may limit what we are trying to analyse, which is a broader concept. Many link achievement to socioeconomic background and poverty. For example, the Benton Foundation analyses the issue from the perspective of under-served youth (Benton, 2002). In Mexico, the reference point is communities at a disadvantage, while in Canada, the example presented refers to rural communities, which were found to have lower achievement levels (Galway, 2004). Other countries such as Hungary also refer to disadvantaged youth, to those from marginalised groups, to the socially excluded or to ethnic or linguistic minorities, (Karpati, 2004).

The European Agency for Development in Special Needs Education states that "across Europe, there is no agreed interpretation of terms such as low achievement, handicap, special need or disability. Definitions and categories of particular educational need vary across countries and what maybe con-

1 . Unless separately indicated, all references in the chapter are to papers appearing in this volume.

sidered as a registered, recognised and therefore 'officially' supported special educational need in one country maybe considered as low achievement that does not warrant specialist educational support and input in another. ...Country specific situations and systems mean that different definitions and interpretations of these terms influence subsequent educational strategies and results" (Watkins, 2004).

What can be concluded from this broad and varied perception of low achievement and disadvantaged youth is that countries should base their policies on their specific definition, whether it be one based on performance or on socioeconomic background or other more qualitative variables. This can change considerably the type of support that is granted, and whether policies are targeted to special groups or to provide equitable outcomes. It is a multidimensional issue.

2. Clarify the measurement of outputs or performance

This question is clearly linked to how low achievement is defined. It is also influenced by the availability of information across countries and across time. PISA measures low literacy results, but results available from it at the time of the workshop measure achievement only at one point in time[2]. Korea defines low achieving students as those who are within the normal range in IQ but do not reach minimum standards either in the 3R's (reading, writing, and arithmetic) or in subject matter at grades 1 to 10 (Ministry of Education, 1997). Its measures of improvement are based on these values. However to understand the impact of ICT on educational performance, there needs to be either comparison across time in tests or the use of other values for measurement. Educational outcomes of policies geared to low achievers have resulted in enhanced self-esteem, learning attitudes, collaboration with peer groups and motivation and interest, which are ultimately attributed to achievements in basic skills.

More qualitative studies have found that ICT has somewhat different impacts than might be expected. Pelgrum's paper in this volume presents the results of SITESM2, a qualitative study of the application of information technology in education. It tells a story of positive effects upon motivation, self-esteem and self confidence: for teachers as well as for students. While positive findings such as these might not be visible in terms of tested performance, they are extremely valuable for students and teachers. In Mexico and Hungary for example, this impact means empowerment of individuals, as ICT can enhance life or future work opportunities for students from disadvantaged groups. The evidence presented by Liisa Ilomaki in a Finnish school also shows that ICT changes schooling and working methods: encouraging problem-based learning, inquiry learning, more independent and responsible learning (Ilomaki, 2004).

The PISA student questionnaire includes questions on students' perception of computer availability and use. The analysis of this data presents differences between low and high achieving students. The general trend is that low achievers have greater access to and use of computers at school than at home. Also, in some countries low achievers have less access to computers in schools that do not have many computers available. There is also a strong trend among low achieving students to feel less comfortable using computers and to feel they have less ability to use them. This data show once more the existence of a digital divide, but defined in terms of achievement level rather than in terms

2 . More information is available in the PISA website http://www.pisa.org.

of national or family economic resources. The findings emphasise the fact that the availability of computers at school can be an important compensatory mechanism in society, even if they cannot be demonstrated to improve standard performance. This might be an important objective of policy.

Another important policy aim, when introducing ICT to schools, might be to provide ICT skills. In this sense, greater access to computers for low achievers and disadvantaged students is contributing to the development of ICT skills, which more and more are seen as an important set of skills needed to function in the knowledge society. This is an important goal from an equity perspective.

It might be necessary to change the measurement of outputs - the way we view what needs to be measured - and to provide other methods of gauging effectiveness. Factors that it is important to assess include motivation, as well as changing pedagogical methods such as the adoption of greater team work and the increased adoption of individual learning. These are key aspects in improving the performance of low achieving students in the long run. The achievement of ICT literacy is another valuable output from the adoption of ICT in schools, especially for those who do not have access at home.

3. A role for the public sector

One of the key questions that emerges from most of the articles presented in this volume is whether public policy should focus on equal access or have a *special* focus on low achieving and disadvantaged or at-risk youth. Because the impact of ICT on the performance of low achievers is not clear, it is also not clear to what extent there public investment in ICT should be concentrated on these groups. To a great extent, most public policy programmes have concentrated on providing access to special groups to obtain equitable outcomes.

The European Union has explicitly referred to the need for equality in the knowledge society, and states the need to pursue social inclusion through e-inclusion. E-inclusion can be reached through 1) the development of basic skills to use digital technologies in daily lives, 2) digital and media literacy and 3) access to online and technology-based information. A specific E-Learning initiative of the European Commission plans to equip schools, train teachers, develop educational services and software, and speed up school networks (Belisle, 2004). Developing universal access that can contribute to greater equitable outcomes is the clear European Union policy goal.

Individual OECD countries have adopted equity-related policies. The Canadian example shows how a Centre for Distance Learning and Innovation provides ICT tools to assist those in isolated rural communities who might not be able to attend schools to obtain a regular high school education. In Denmark, different projects have dealt with the use of ICT to avoid segregation of schools' students. In Finland, there is special targeting to improve learning outcomes of disadvantaged students, measures which include using ICT in education for early learners and school leavers. In Germany there are specialised programmes or special support for disadvantaged students. In Italy, there are special ICT initiatives by the Ministry of Education for the integration of disadvantaged students into the regular classrooms. In Korea a diverse range of policies are in place to target low achieving students and to integrate ICT into the classroom. Chilean experience with the Enlaces programme has shown that there while there is no correlation between national test scores and the Enlaces programmes, there are other impact: for example without Enlaces, the majority of Chilean students who attend subsidised schools would not use ICT.

In some countries, policies have been the design at a national level, with their application or more specific development occurring at the local or even at school level. In Denmark, there are national policies for equity in education, with action taken at the local or regional level to ensure the best prioritisation of needs. In Finland, there is financial steering by the government, while the local level plays and important role. Wilhelm presents examples from the United States and Germany in which programmes were designed at a national level, but it was then up to the states or local institutions to take them up. This was the case with the US e-rate programme.

Finally, investment in ICT at school requires sustainability. Sustainability requires a number of different steps: investment in teacher training; infrastructure development and updating; and establishing connectivity. A number of countries have adopted short-term knowledge economy or knowledge society policies, without thinking of the longer term impact. Policies should be conceived so as to be sustainable; with classrooms, teachers and students having access to hardware and software that is updated and for which there is maintenance. The example of Chile's Enlaces programme, whereby a web of universities provided support services to local schools, can be highlighted here.

4. Adopt a holistic approach

The adoption of a holistic approach has been viewed as a way of rationalising different policies and investments, of bringing key partners together, and of obtaining the best possible results. There was agreement in most of the papers presented at the workshop, and especially from speakers from lesser developed countries, on the need to provide a holistic approach in order to improve the results of low achievers and disadvantaged students.

The adoption of a holistic approach has two dimensions. On the one hand, it refers to the need to bring together the different partners involved in designing and delivering ICT policies that may affect educational institutions. The evidence presented by countries shows that in many cases a range of policies may be designed and delivered by different ministries or agencies without coordinating their actions. Many countries have general information society action plans, as it is a cross cutting subject that has different public policy realms, and within them there might be educational programmes. Other countries might have specific education and ICT policies, some might have only general science and technology policy that impact on schools. Wilhelm states that "With various ministries and departments motivated by different goals and accountability structures taking divergent approaches to an information society agenda, clearly there are gaps and redundancies in composing comprehensive solutions for underserved youth. Piecemeal approaches to content development, training, R&D and infrastructure coverage will hinder countries in reaching their information society goals" (2004).

On the other hand, a holistic approach refers to the need to extend these policies so that they impact disadvantaged youth in different ways: in the home as well as at school. This involves curriculum development, teacher training and development, contributing to community development, out-of-school support, and parental support. It involves community-wide programmes that empower the students. Canada, Chile, Finland, Hungary, Korea and Mexico are all countries where holistic policies targeted to disadvantaged youth have obtained positive results. In Korea and Finland, both countries which have had good and equitable results in PISA, a range of policies targeted to different aspects of the development of low achievers have been applied. Korea for example has a remedial

programme, a subject teaching and learning advice service, a multimedia content development and service centre, and even a programme to teach ICT skills to students' parents. In Mexico and Chile, schools are opening up to share their ICT resources with the communities in which they are located. Another example is the Banamex Foundation in Mexico, which is based on the adoption of community development to generate self-managed, sustainable and productive indigenous organisations (Santillan, 2004).

Within this holistic approach, teacher training and development has been highlighted as extremely important, and is included in many approaches to the use of ICT in education. According to many researchers, policy makers and practitioners, more needs to be done. Countries recognise that teachers' too limited familiarity with ICT might be a weakness of policies. Countries that have been more successful have invested heavily in this. Denmark, for example, has developed policies highly focused on teacher support and development, by focusing on the provision of an educational IT drivers license for teachers and a network of ICT educational advisers for teachers. Norway is intensifying the development of digital teaching aids to supplement traditional methods.

Finally, the adoption of a holistic approach also calls for more research on this subject. The impact of ICT on low achievers' educational performance has not been clarified completely. Many suggest measuring other outcomes apart from standard test results. There is also a need for the impact of policies to be further analysed. Case studies of best (and not-so-good) practices need to be prepared. Trend analysis also can help further understand this subject. There are international databases available, which are quite recent, and these can provide a rich source of information to disentangle this question of the impact of ICT on low educational achievement. And the results of this research needs to be shared across countries.

Coherent and holistic policy approaches may contribute to improving outcomes of low achievers and disadvantaged youth. But there need to be clear definitions of who the target groups will be and of the outcomes that are desirable, and a clearer understanding of the kinds of policies which might be more effective in reaching equity objectives. ICT may contribute to more student-oriented learning, to increased motivation, to improved self esteem and confidence, and these may in turn improve achievement.

REFERENCE

BENTON FOUNDATION (2002)
Toward digital inclusion for underserved youth, A transatlantic roundtable: Summary and next steps.

OECD/Hungary Workshop
Budapest, Hungary, 12-13 June 2003

**PROMOTING EQUITY THROUGH ICT IN EDUCATION:
PROJECTS, PROBLEMS, PROSPECTS**

PARTICIPANTS LIST

ALLEMAGNE
GERMANY

Ursula ESSER

Head of section "International Affairs"
Schulen ans Netz e.V.
Max-Habermann-Str. 3
53123 Bonn
Germany

Tel:
Fax:
Email: ursula.esser@schulen-ans-netz.de

BELGIQUE
BELGIUM
Communauté française
French Community

Baudouin BRANDERS

Chargé de mission (Administration générale de l'Enseignement et de la Recherche scientifique)
Rue Belliard 9-13
1040 Bruxelles
Belgium

Tél. :+32 2 213.59.34
Fax : +32 2 213.59.91
Email : baudouin.branders@cfwb.be

CANADA

Gerald GALWAY

Assistant Deputy Minister
Planning & Educational Programs
Department of Education
P.O. Box 8700
St. John's NL A1B 4J6
CANADA

Tel: + 1 (709) 729-5397
Fax: +1 (709) 729-0414
Email : geraldgalway@gov.nl.ca

COMMISSION EUROPEENE
EUROPEAN COMMISSION

Claire BÉLISLE

LIRE-CNRS
ISH (Institut des Sciences de l'Homme)
14 ave Berthelot
69363 Lyon
Cedex 07
France

Tel: + 33 (0)4 72 72 65 21
Fax: + 33 (0)4 72 72 65 51
Email: Claire.Belisle@ish-lyon.cnrs.fr

CHILI **CHILE**	**Juan Enrique HINOSTROZA**	Director Instituto de Informática Educativa Universidad de la Frontera Universidad de la Frontera Montevideo 0830 Casilla 380, Temuco Chile Tel: 56 (45) 325 252 Fax: 56 (45) 325 263 Email: ehinost@iie.ufro.cl
	Magdalena CLARO	Head of Studies Division National School Network, Enlaces Ministry of Education Red Enlaces, Ministerio de Educación Alameda 1595, piso 10 Santiago Chile. Tel: 56 (2) 390 4953 Fax: 56 (2) 390 4778 Email: mclaro@mineduc.cl
CORÉE **KOREA**	**Myung-Sook PANG**	Researcher Policy Research Division, KERIS Arirang Tower, 1467-80, Seocho-dong, Seochogu Seoul, 137-070 Republic of Korea Tel : 82-2-3488-6387 Fax : 82-2-3472-8907 Email: jean@keris.or.kr
ESPAGNE **SPAIN**	**José Andrés RUIZ DE JUAN**	The Secretary of Education
	Javier RICO RUBIO	The Secretary of Education
FINLANDE **FINLAND**	**Jouni KANGASNIEMI**	Senior Adviser (Development) Ministry of Education P.O. Box 29 FIN - 00023 Government Finland Tel: + 358 9 1607 7359 Fax: + 358 9 656 765 Email: jouni.kangasniemi@minedu.fi

	Liisa ILOMÄKI	Vanhempi tutkija Verkko-oppimisen ja tiedonrakentamisen tutkimuskeskus Psykologian laitos PL 9 (Siltavuoren penger 20D), 00014 Helsingin yliopisto Finland GSM: +358-50-5114376 Fax: +358-9-19129443 Email: liisa.ilomaki@helsinki.fi
FRANCE	**Nadine PROST**	Ministère de l'éducation nationale Chargée de mission OCDE “Education” Délégation aux relations internationales et à la coopération Bureau des institutions multilatérales et de la francophonie 4 rue Danton 75006 Paris France Tél : + 33 (0) 1 55 55 75 31 Fax : + 33 (0) 1 55 55 61 23 Email: nadine.prost@education.gouv.fr
	Alain LAMBERT	Expert de la direction de la technologie du ministère.
HONGRIE **HUNGARY**	**Andrea KÁRPÁTI**	Chairholder UNESCO Chair for ICT in Education Faculty of Sciences, Eotvos University Pazmany setany 1/a H-1117 Budapest Hungary Tel: + 36 1 372 2961 Fax: + 36 1 372 2948 Email: karpatian@axelero.hu
	Pál ALMÁSI	Almási Utcai Általános Iskola director 6990 Makó Almási u. 52. Hungary/Csongrád County Tel: 62 – 219-259 Fax: 62 – 210-446 Email: paja@almasi.hu

Péter FEHÉR

Eötvös University, Budapest
Lecturer
Pécs, H-7632 Anikó u. 12.
Hungary

Tel: 36/72/518-595
Email: Feherp@axelero.hu

István FOGARASI

IBCnet Hungary Ltd.
Sales manager
Zsigmond tér 10.
Budapest
8200 Hungary

Tel: +36 1 345-2283
Fax: +36 1 345-2211
Email: Fogarasi_i@ibcnet.hu

Ferenc HARGITAI

MATISZ
Kuny Domokos u. 13. III.em. 311.
Budapest 1012
Hungary

Tel: +36 1 213-5089
Fax: +36 1 375-9722
Email: info@matisz.hu

Elsayed HASSAN

BMF, KVK, HMI.
Deputy Director
1084 Bp. Tavaszmező u. 17.
Hungary

Tel: + 36 −1-210 14 32
Fax: +36 −1-210 14 32
Email: hassan@nfs.jozsef.kando.hu

Bertalan KOMENCZI

Eszterházy Károly College, Eger
associate professor
H-3200 Gyöngyös, Attila utca 12.
Hungary

Tel: +36 20 9718219
Fax : +36 36 520437
Email: kbert@axelero.hu

János LUKÁCS
Budapesti Műszaki Egyetem
Műszaki Pedagógiai Tanszék
Egry J.u.1
Budapest 1111
Hungary

Tel: +36 1 463 1111
Fax: +36 1 463 16 97

Katalin MUNKÁCSY
Eotvos University, Budapest
Senior lecturer
H-1075 Rumbach 3.
Budapest
Hungary

Tel: 36 1 3227594
Email: munka@ludens.elte.hu

Zsuzsa SZALAYNÉ TAHY
Szent István Gimnázium
Teacher
1048 Budapest, Homoktövis u. 107
Hungary

Tel: +36 30-919-8831
Email: sztzs@axelero.hu

Balázs TÖRÖK
Hungarian Institute for Educational Research
Research worker
1054 Budapest, Báthori utca 10.
Hungary – 1054

Tel: (36) – 1 – 302 – 77 – 49
Fax: (36) – 1 – 302- 77 – 49 / 125
Email: torokb@ella.hu

Éva TÓT
Hungarian Institute for Educational Research
Senior research fellow
H-1135 Budapest Szent László út 26 III. 8.
Hungary
(36 1) 330 61 76

Email: toteva@chello.hu

Marta TURCSÁNYI-SZABÓ
Associate Professor, Head of TeaM Lab
Eotvos Lorand University, Informatics
Methodology Group
1117, Budapest Pazmany Peter Setany 1.C.
HUNGARY

Tel: (+36)1 372 2700 /ext 8471
Fax: (+36)1 381 2140
Email: turcsanyine@ludens.elte.hu

	Zoltán VIG	Budapesti Műszaki Egyetem Műszaki Pedagógiai Tanszék Egry J.u.1 Budapest 1111 Hungary Tel: +36 1 463 1111 Fax: +36 1 463 16 97
	Imre VITÉNYI	IBCnet Hungary Ltd. web division manager Budapest, Zsigmond tér 10. Hungary +36 1 345-2222 +36 1 345-2211 Email: vitenyi_i@ibcnet.hu
ITALIE **ITALY**	**Alessandro MUSUMECI**	Ministero dell'Istruzione, dell'Universita' e della Ricerca Servizio Automazione Informatica e Innovazione Tecnologica Direttore Generale Viale Trastevere 76-00153 ROMA Tel. 06/5849.3608-3606 Fax: 06/5849.2252 Mobile: 329/42.05.201 Email: alessandro.musumeci@istruzione.it
NORVÈGE **NORWAY**	**Margrethe MARSTRØM SVENSRUD**	IT-manager Vox, national institute for adult learning P.O.Box 6139 Etterstad NO-0602 Oslo NORWAY Tel: + 47 23 38 13 23 Fax: + 47 23 38 13 23 Email: Margrethe.Svensrud@VOX.no
	Siv Merethe LIEN	Adviser Ministry of Education and Research Departement of Education and Training P.O.Box 8119 Dep NO-0032 Oslo NORWAY Tel: +47 22 24 72 63 Fax: +47 22 24 27 15 E-mail: sml@ufd.dep.no

SLOVAQUE REPUBLIQUE
SLOVAK REPUBLIC

Roman BARANOVIC
Institute of Information and Prognoses of Education
Stare Grunty 52
842 44 Bratislava
Slovak Republic

Tel: +421 2 654 26 568,
Fax: +4212 654 26 180,
Email: roman.baranovic@infovek.sk

Viera HAUSKRECHTOVÁ
Counsellor
Dept. of Special Education
Ministry of Education of the Slovak Republic
Stromová 1
813 30 Bratislava
Slovak Republic

Tel: + 421 2 59374 306
Fax: +421 2 5477 1281
Email: viehaus@education.gov.sk

Alena HASKOVA
Institute of Technology of Education
Faculty of Education
Constantine the Philosopher University
Tr. A. Hlinku 1
949 74 NITRA
Slovak Republic

Tel/Fax: +421-37-6511013
Email: ahaskova@ukf.sk

Jozef POLAK
Institute of Technology of Education
Faculty of Education
Constantine the Philosopher University
Tr. A. Hlinku 1
949 74 NITRA
Slovak Republic

Tel/Fax: +421-37-6511013
Email: jpolak@ukf.sk

Pavol BOHONY
Institute of Technology of Education
Faculty of Education
Constantine the Philosopher University
Tr. A. Hlinku 1
949 74 NITRA
Slovak Republic

Tel/Fax: +421-37-6511013
Email: pbohony@ukf.sk

	Anna HECHT	Educational section of the country office Head Odbor školstva MaTK - Okrený úrad Al betínské nám. 1194/1, 929 01 Dunajská streda Slovakia Tel: +42 1 905439111 Fax : +42 1 315901594 Email : osmt@ds.vs.sk
SLOVÉNIE **SLOVENIA**	**Alenka IBERT**	Advisor for ICT in education National Education Institute Poljanska 28, SLO – 1000 Ljubljana Slovenia Tel: +386 1 3005 182, Fax: +386 1 3005 199 Email: alenka.zibert@zrss.si
SUISSE **SWITZERLAND**	**Francis MORET**	CTIE Director SFIB – CTIE Erlachstrasse 21 CH-3000 Berne 9 Switzerland Tel + 41 (0)31 301 20 91 Fax + 41 (0)31 301 01 04 Email: f.moret@sfib-ctie.ch
	Caroline DELACRÉTAZ	Cheffe de projet Centre suisse des technologies de l'information dans l'enseignement (CTIE) Erlachstrasse 21 CH-3000 Berne 9 +41 (0) 31 301 20 91 Email: c.delacretaz@educa.ch
TURQUIE **TURKEY**	**Serpil YURUKER**	Instructional Designer General Directorate of Educational Technologies, Teknikokullar, 06500 Ankara TURKEY Tel: (+090) 312-212 50 84 (Ext: 9752) Fax: (+090) 312-213 87 36 Email: syuruker@meb.gov.tr

EUROPEAN AGENCY FOR DEVELOPMENT IN SPECIAL NEEDS EDUCATION	**Amanda WATKINS**	European Agency for development in special needs education Teglgaardsparken 100 DK – 5500 Middelfart Denmark www.european-agency.org Email: amanda@european-agency.org
UNESCO	**Michael BÜRGER**	Substitute for Chairholder UNESCO Chair of communication University of Konstanz Department of Information Science Tel.: +49 7531 88-2870 Fax : +49 7531 88-2048 Email : Michael.Buerger@inf.uni-konstanz.de
EXPERTS	**Tony WILHELM**	Vice President for Programs The Benton Foundation 1625 K Street N.W., 11th Floor Washington D.C. 20006 The United States Tel: (202) 638-5770 Fax: (202) 638-5771 Email: tony@benton.org
	Marcela SANTILLÁN NIETO	Rectora Universidad Pedagógica Nacional Carretera al Ajusco No. 24 Col. Héroes de Padierna Delegación Tlalpan, C.P. 14200 México, D.F. Tel: 52 (55) 5645 6213 and 52 (55) 5645 6469 Fax: 52 (55) 5645 5340 Email: m.santillan@upn.mx

	Hans PELGRUM	Department of Curriculum Faculty of Behavioral Sciences University of Twente P.O. Box 217 7500 AE Enschede the Netherlands Email: W.J.Pelgrum@edte.utwente.nl
OECD **TUAC**	**Roland SCHNEIDER**	Senior Policy Advisor TUAC 26, avenue de la grande armee F 75017 Paris France Tel. ++33 1 55 37 37 37 Fax : Email : schneider@tuac.org
OCDE **OECD**	**Richard SWEET**	Principal Administrator Education and Training Policy Division Directorate of Education OECD 2, rue André Pascal 75775 Cedex Paris FRANCE Tel: + 33-1-45-24-16-61 Fax: + 33-1--44 30 62 20 Email: Richard.Sweet@oecd.org
	Beatriz PONT	Administrator Education and Training Policy Division Directorate of Education OECD 2, rue André Pascal 75775 Cedex Paris FRANCE Tel: + 33-1-45-24-18-24 Fax: + 33-1-44 30 62 20 Email: Beatriz.pont@oecd.org