E-Learning Policy to Transform Russian Schools

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# TABLE OF CONTENTS

ACKNOWLEDGMENTS ................................................................................................................ iii

EXECUTIVE SUMMARY ................................................................................................................ iv

THE SITUATION TODAY AND ITS BACKGROUND ................................................................. v

INTRODUCTION ........................................................................................................................... 1

    Integrating Education Reform with ICT ................................................................. 1
    The Reform Agenda .............................................................................................. 3

FOCUS ON KEY ISSUES ............................................................................................................. 5

    Access and Equity .............................................................................................. 6
    New Ways of Teaching and Learning ............................................................... 9
    ICT Literacy and Advanced ICT Skills Development .................................. 11
    Summary of Key Issues ................................................................................ 11

THE SITUATION TODAY AND ITS BACKGROUND .......................................................... 12

    The Bank and Russian Education Reform .................................................. 12
    Russia’s Digital Experience in Education .................................................... 13
    Federal Policies and Programs for Improvement ..................................... 15
    Private Sector Initiatives ........................................................................... 16
    Public Support ............................................................................................. 18
    Barriers to Effective Introduction of ICTE ................................................. 18

POLICY OPTIONS AND RECOMMENDATIONS .................................................................... 21

    Recommendations: Policy Development and Strategy Management ........ 21
    Recommendations: Efficient Use of Resources ......................................... 24
    Recommendations: Equalizing Access to Better Education by Means of ICT 26
    Recommendations: Enhancing Teaching and Learning for the Information Age 27
    Recommendations: ICT Literacy Skills Development ................................ 30
    Role of the Federal Ministry ........................................................................ 30

CONCLUDING STATEMENT ....................................................................................................... 31

Appendix 1: Krasnoyarsk Region Case Study ................................................................. 33
Appendix 2: Irkutsk Region Case Study ........................................................................... 68
Appendix 3: The Russian Education System – Basic Data ........................................... 92
Appendix 4: E-Learning and Distance Education in Russia ..................................... 101
References .......................................................................................................................... 117
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EXECUTIVE SUMMARY

INTRODUCTION

Russia is reforming its education system to meet the needs of the country’s evolving economic structure with its changing focus on information and services. This is known as the information – or knowledge – economy. The reform effort is now being expanded to incorporate the support that technology can give to new systems of teaching and learning. Currently the Government of Russia is investing a significant part of its limited education budget into ICT equipment for general schools and initial vocational education. The report intends to help to maximize the social and educational impact of these investments.

This report focuses on the analysis needed to facilitate ICT integration at the level of general and initial vocational education (IVE). Both the general and the vocational streams have fallen behind higher education (HE) in the introduction and integration of ICT. However, IVE has been particularly neglected, not only in respect of funding for hardware and software, but also in the design of a curriculum appropriate to potential employers. From the other hand, recent international researches demonstrate that Russian general education falls behind education systems of developed countries.

The report identifies the three primary issues of educational reform, as recognized internationally, and discusses them in terms of the part that can be played by ICT. Russian understanding of the needs created by this synthesis breaks down as follows: equal access to quality education; enhanced teaching and learning relevant to the information age; and appropriate skills to be developed by students.

The report then describes the situation in Russia as it exists today, including measures already taken by the government and others, and the continuing barriers to reform. It ends with a section listing policy options and recommendations that look towards the medium and long term. Looking towards the short term, the report concludes with three broad priority recommendations for early or more immediate action.

This report concentrates on policy issues. It reviews developments in the context of the three key issues identified above. The report has been developed by the World Bank education team and is based on research and interviews with key policymakers and stakeholders at the federal and regional levels throughout the Russian Federation.

FOCUS ON KEY EDUCATIONAL ISSUES

In this section, we discuss the three key issues for education reform in the Russian context and the role in reform success of the introduction of information technology.

Access and Equity

In recent years, many experts have mentioned the alarming movement of a previously equitable Russian general education system towards a quite stratified and unequal system. They think that this issue is the most important and critical for the future development of Russian education (World Bank 2000, unpublished). They think that two major determinants of inequality are income difference and city-village inequality of access to resources. It is the view of the World Bank (and consistent with international experience) that the provision of access to education through ICT is the way in which the risk of this divide will be minimized. However, in Russia, to date, lack of equipment, of production of quality electronic learning materials, and of the delivery of such materials is hindering this possibility. Moreover, most of Russia's efforts so far to embrace ICT in education have only accelerated the widening of a digital
divide between wealthy and poor schools and institutions, and between general and IV education students. It is hoped that the recently initiated presidential program, *Computers for Rural Schools*, will mark a reversal of this trend.

**New Ways of Teaching and Learning**

ICT as introduced today has not yet become a catalyst for important change in Russian education. However, the widespread use of ICT in education could support Russia's current educational reform agenda; this agenda includes the following: development of learning outcomes appropriate for citizens in an information economy, changes in teaching methodology toward student-centered practices, education content renewal, curriculum diversity, and development of flexible organizational forms. Moreover, it is difficult to see that these goals can be practically achieved in a timely manner without ICT support.

**ICT Literacy and Advanced ICT Skills Development**

The most obvious justification for introducing ICT into schools and IV institutions is to give students the tools to be productive in an ICT reach economy. Thus, one outcome should be their mastery of ICT related skills, attitudes, and knowledge. It can be achieved on two levels: universal computer literacy and advanced technological skills. Although courses in the latter are needed to create a skilled IT workforce, they should not be mandatory for all students. Basic universal computer competence – the former – should be.

There are no reliable data on ICT literacy among Russian school students. However, the latest results from the Program for International Student Assessment (PISA) are discouraging since they show reading skills and simple information processing skills declining among Russian children. Until the reform of Russian education is fully implemented, this situation is likely to restrict the spread of computer literacy.

**Summary of Key Issues**

Use of ICT in realizing all three goals of education reform (equalizing access to quality education, improving the quality of teaching and learning, and providing skill training) is very relevant for Russian education. None of these three goals is explicit enough in policy documents. The means of achieving all three are interconnected, and it would be beneficial if all aspects of ICT in education strategy could be reviewed from these three standpoints. The most urgent issue is the first – equality of access. The digital divide is growing in Russia: new policies and programs must ensure that they do not foster that growth. The second goal is the most challenging: use of ICT in support of the provision of new ways of teaching and learning to achieve new learning outcomes suitable for application in a new kind socioeconomic environment.

**THE SITUATION TODAY AND ITS BACKGROUND**

**Russia’s Digital Experience in Education**

As early as the middle sixties, Russia under Soviet rule had recognized the importance of computer technology. Computers were introduced into general education with the aim of achieving a technological breakthrough for the USSR through development of information and computer literacy in all general school graduates. Special software was developed and teachers were trained. At the beginning of the nineties, up to 28 percent of schools were equipped with computers, mainly of Soviet make.
Neither the USSR then, nor Russia since, was able to sustain these pioneering efforts. The
decentralization and underfunding of the Russian education system in the nineties resulted in a growing
inequity of ICT availability across the education system. During that time, the only significant forward
movement in the use of ICT in education was seen in higher education (HE). For the most part, because
of the division of responsibilities for education between regional and federal levels, the push was
uncoordinated. It had no clearly recognizable and coherent strategy for changing either educational
content or methodologies. It also led to such a degree of diversification in technical specifications and
software standards that it closed the door to any subsequent systemwide approach. The net effect is that
investment in ICT in higher education in Russia has had very few flow-on effects to other levels of
education and has generally been at their expense. By the late nineties, Russia had become the only
country with an increasing student to computer ratio in schools, a situation caused in part by the
obsolescence of the first generation computers installed in the eighties.

Russia’s recently improved economic and political stability is changing the picture. Russia can now
afford to recognize the urgent need to embed ICT in its educational practices in both general and
vocational education. Moreover, there is a clear change of attitude toward ICTE in Russian society. The
general public understands the importance of ICT. School administrators, teachers, and the teachers’
union also now see ICT as an important part of the reform agenda – a comparatively recent development.
At the political level, too all parties have acknowledged the importance of ICTE.

Public and Private Initiatives in ICTE

In the public sector, parallel with two presidential initiatives for installing modern computers in urban and
rural schools, the federal government has initiated two key policy programs that include measures to
accelerate the introduction and integration of ICTE in both general and IV schools. They are Development
of the Common Education Information Space for 2001–2006 (E-Education for short), published in August
initiatives are perceived as a key condition for integrating Russia into the community of developed
countries and are taking place in an environment conducive to change. However, although the programs
are interrelated, there is no clear mechanism for their administrative coordination. There is also no
mechanism to coordinate the efforts of the federal government with diverse regional and institutional
initiatives.

Three private sector initiatives mark interesting developments in educational funding. However, only the
first is of direct relevance to general school needs and is aimed at providing a systemic change. It is the
teacher training program started in 2000 by the Yukos oil company with the main goal of introducing
Russian teachers to ICT in general and to the Internet in particular. The other two private ventures are the
OSI auditorium.ru education portal initiative and the Teleschool project.

As much as it is in the interests of the private sector to donate to schools, their generosity has been limited
by the obligation of the donors to pay taxes on such gifts. A possible change in the law may give private
enterprise an incentive to donate ICT equipment to general or IVE schools.

Barriers to Effective Introduction of ICTE

Despite the emergence of highly relevant government policies and programs, public support, and Russia's
natural wealth of talent, Russia faces huge difficulties in equipping its people with the skills necessary to
compete in an information economy. Russia's huge landmass, thinly spread population, lack of available
finances, and regional diversity all bring daunting challenges, especially to the setting up of effective
connectivity and digital networks.
There are also education-related hurdles to overcome. National ICTE strategy development is hampered by a lingering input orientation under which progress is measured by indicators such as student-to-computer ratios and bandwidth rather than student learning outcomes or social and economic effects. Serious coordination problems, a lack of reliable education statistics for program preparation, and inadequate regulatory frameworks also need early attention. In the last resort all these obstacles hinder the orientation of students to lifelong learning that is such an important objective for educational reform.

All these barriers to the effective introduction of ICT in general and initial vocational schools are important. But of them all, two are the most important. These are, first, weak coordination of effort and programs caused by the divergent thrusts of institutional and sectoral interests; and, second, a restricted vision of the possible impact of the introduction of ICT, leading officials to adhere to a focus on technological inputs rather educational outcomes.

**POLICY OPTIONS AND RECOMMENDATIONS**

This section summarizes recommendations on further strategy development for the effective use of ICT in general and initial vocational education.

**Recommendations: Policy Development and Strategy Management**

This subsection focuses on achieving an effective ICT management strategy for education and for efficient use of public resources.

- **Vision and goals**
  - The Ministry of Education should orient the ICTE strategy not to inputs but toward outcomes relevant to the government social and economic development program, ensuring cooperative links with participating agencies and other programs in the area of ICT.
  - ICTE strategy should take full advantage of preparatory analytical work including social impact studies, and analysis of lessons from international experience in ICT strategy development and implementation.

- **Regulatory framework**
  - The government should revise and strengthen the regulatory framework, ensuring effective use of ICT in education.
  - The Ministry of Education should define responsibilities for the introduction and use of ICTE at federal, regional, local, and institutional (school) levels. This will enhance coordination of public involvement in education and the action of government agencies.

- **Essential steps in introducing ICTE**
  - The essential steps and sequence of tasks as a long-term strategy in introducing ICT in Russian education should be determined and followed. They should have clearly defined outputs for each step that are linked to educational goals.

**Recommendations: Efficient Use of Resources**
Russia has very limited resources for investment in ICT in education. Those resources need to be allocated very carefully. Difficult choices in the following areas must be made in relation to existing tradeoffs as listed below:

- **Connectivity and equipment**
  - Goals should be oriented towards providing universal service rather than universal connectivity.
  - Federal financial support should be directed to solving the last mile problem.

- **Maintenance, upgrading, and supply**
  - Maintenance, upgrading, renewal of supplies should all be treated as regular expenses within education budgets.
  - Economies of scale should be employed to reduce unit costs wherever possible.

### Recommendations: Equalizing Access to Better Education by Means of ICT

This subsection focuses on support for disadvantaged populations in gaining access to ICT and on the role e-learning materials can play in broadening access to content.

- **Targeted support**
  - ICT programs should target disadvantaged populations, including IVE institutions, for special needs-based support and ensure their access to new learning resources.

- **The role of E-learning materials in equalizing access to improved resources**
  - The delivery potential of ICT should be harnessed to increase and broaden the availability of learning materials for general and IVE education systems and teacher training especially in remote and rural areas.

### Recommendations: Enhancing Teaching and Learning for the Information Age

This subsection focuses on the training and support of teachers, on the building up of multimedia learning materials and a system of portals to educational networks, and on resulting changes to the teaching environment.

- **Teachers**
  - The Russian government should make training and on-going professional support of teachers in the use of ICT its first priority in planning to introduce ICT to general and IV education. Possibilities for equipping teachers with their own computers should be considered.

- **Building content and resource development capacity**
  - An integrated, cross-level system of education portals should be set up after in-depth study of international experience.
  - E-learning and distance support materials for use in general and IV schools should be designed and developed for delivery via a range of media appropriate to the end user.
  - A national collection of e-learning materials should be established.
- The capacity to produce modern multimedia learning materials should be built; for this, instructional designers should be trained and best practice models used.

- The impact of ICT on school organization and on teaching and learning practices
  - Introduction of ICT in education will require far-reaching institutional changes in the system of education, in general schools, and in IVE institutions.

**Recommendations: ICT Literacy Skills Development**

This subsection focuses on measures needed to ensure all students are adequately literate in ICT and that students receptive to advanced skills are not neglected.

- Universal ICT literacy
  - Modular courses should be developed that ensure students leave school with the ICT literacy skills needed to function in an information economy. Universal standards for evaluation and certification of these skills should be developed and implemented as part of a regular evaluation process. Similarly, courses should be developed to ensure that IVE graduates acquire competence in ICT appropriate for the corresponding new and emerging industries of the information economy.

- Advanced ICT skills training
  - Modular training courses in advanced ICT skills should be available for students from general schools and IVE institutions, as well for adults.

**Concluding Statement**

With the release of its broadly based *E-Russia* and *E-Education* policies, the Russian government has made a courageous start on the long and arduous task of equipping its citizens to compete effectively as creative members of the global information economy. It now needs assistance in further development and implementation of its policies.
INTRODUCTION

Russia is reforming its education system to meet the needs of the country’s evolving economic structure with its changing focus on knowledge creation, processing and use. This is known as the information – or knowledge – economy. This effort is now being expanded to incorporate the support that technology can give to new systems of teaching and learning.

The collapse of the Soviet Union brought Russia into a postindustrial global economy shaped by the use of ideas rather than physical strength and by the application of technology to the production of goods and services. This knowledge economy is so fast moving that it requires a workforce composed of individuals flexible enough to adapt to changing circumstances throughout a lifetime. The necessary capacity for lifelong learning is the goal of modern education reform.

In Russia following the breakup of the Soviet Union, it was not at first apparent that its proud tradition of providing a high quality education to all citizens was not in itself enough to shape its students for lifelong learning. The process of educational reform started only after it became apparent that the stability and equity of the system was being threatened by years of underfunding. This realization coincided with the recognition that the loss of an educated workforce would threaten Russia’s ability to develop its own economy and to participate in the world economy. With this realization, it also became clear that a new kind of work force was needed – one that was trained to be self-motivated, make independent judgments, and to be flexible.

It also became clear that the means to create such a work force must be equitably distributed among different sections of the population, reversing the unfair distribution of educational availability resulting from the underfunding that started in 1992.

The use of ICT in teaching academic and other subjects would lead to the development of skills required by modern economy and will encourage a more problem-solving and collaborative approach to learning, to the benefit of labor-market outcomes. International evidence shows that people with new skills of this kind are more likely to get better jobs, regardless of their level of education. More dynamically, improvement in such skills will affect the comparative advantage of the Russian economy – helping to shift it from natural resources and unskilled labor to high-technology skills and to move it up the world table of international competitiveness (see appendix 3, table A3.9, p. 99).

The starting point for this shift is promising; it is founded on the following: the continued high quality of mathematics and science education (see appendix 3, figure A3.6, p. 97); the compressed distribution of wages by level of education, with university graduates earning less than twice as much, on average, as those with elementary education (see appendix 3, table A3.10, p. 100); and the low wages (in dollars) of Russian ICT specialists compared with their counterparts in competitor countries (see appendix 3, table A3.11, p. 100). Russia is, thus, in a good position to leapfrog into new, internationally competitive ICT-based and other skill-based sectors.

Integrating Education Reform with ICT

These considerations, based on the experience of the developed world, made it clear that education and training must be integrated with the support that could be provided by information and communication technology (ICT). It is now recognized in Russia that ICT in education (ICTE) is important enough to be considered a catalyst for reform. This understanding has been accompanied by the creation of two important federal programs, one entitled Development of the Common Education Information Space for 2001–2006 (E-Education for short) and published in August 2001, and the other entitled Electronic
Russia for 2002–2010 (E-Russia for short), and published 28 January 2002. Their common strategy includes the acceleration of the introduction and integration of ICT in education (ICTE) and is described in the section on federal policies and programs.

This report focuses on the needed analysis to facilitate ICT integration at the level of general and initial vocational education (IVE); this is the level that covers the primary and secondary school age groups – the age ranges where change in learning techniques must begin.

So far, however, the connection between educational reform and the use of ICT skills in the revised process of teaching and learning is not strong, and the two programs (E-Education and E-Russia) have tended to develop in isolation. There is, thus, a danger of them getting out of step with each other, creating a situation in which hardware provision and its rapid obsolescence could outrun curriculum design and appropriate software development.

A Starting Point for Integration

The process of developing a balanced strategy for ICTE should start by identifying those changes to the Russian education system needed to develop an information based economy and knowledge society. Stakeholders can then determine ways in which integrating ICT in educational practices can assist in bringing about the required changes. This process has begun in places, but for the most part, course content and teaching methodology are still in development. Therefore, this report concentrates on policy issues, after summarizing the reasons and the agenda for education reform.

The report first identifies the three primary issues of educational reform, as recognized internationally, and discusses them in terms of the part that can be played by ICT. The three issues are as follows equal access to quality education, enhanced teaching and learning for the information age, and the appropriate skills to be developed by both teachers and students. The report then describes the situation as it exists today, including measures already taken by the government and others and continuing barriers to reform. It ends with a series of policy options and recommendations that look toward the medium and long term and conclude with four broad recommendations for early or more immediate action.

The first of the three reform issues has serious implications for both society and individuals, because the digital divide (DD) is growing in Russia. Without appropriate skills, many currently underprivileged young people will increasingly find themselves out of step with the needs of the modern employment market.

Discussion under the second issue explores the development of a pathway for integrating ICT into the planned education reforms; of the three objectives, this is the most challenging – use of ICT to support the provision of better quality education. The latest results from the Program for International Student Assessment (PISA) show that Russian children perform worse, relative to their counterparts in OECD countries, in tests of their ability to use reading, mathematical, and scientific skills to meet real-life challenges than in tests (such as TIMSS) of their mastery of a specific school curriculum. The use of ICT in teaching all subjects can strongly support a shift in learning strategies and outcomes toward the

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1 Russian schools outside the vocational sector are designated as “general education schools,” and these schools offer classes for students in grades 1 through 11. With the exception of a small number of rural schools, the majority of schools are not separately designed as “primary” or “secondary.” Since the majority of general schools serve students at both primary and secondary levels, this part of the education system will also be referred to here as “secondary education.”
acquisition of the new, flexible, problem-solving skills and collaborative approach to work that are needed today.

Discussion under the third issue will look at ICT literacy as an essential tool in modern economies that students must master to be productive in the adult/working world. There are no reliable data on ICT literacy among Russian school students but, to judge from their answers to PISA interviewers, they feel less comfortable with computers and less confident about their ability to use them than do their counterparts in OECD countries (on average).

Both the general and the vocational streams have fallen behind higher education (HE) in the introduction and integration of ICT; however, IVE has been particularly neglected, not only in respect of funding for hardware and software, but also in the design of a curriculum appropriate to potential employers. This is an important lack in view of the significance for economic development of the kinds of skills that can be taught through IVE. It also further discriminates against low-income students who tend to gravitate to IV institutions as the more direct route to earned income.

The report has been developed by the World Bank education team and is based on research and interviews with key policymakers (including the minister and deputy ministers of education, members of the parliamentary committee) and stakeholders at the federal and regional levels throughout the Russian Federation. It also draws on information made available to the Bank during visits to Krasnoyarsk and Irkutsk in October 2001 (appendixes 1 and 2) and on local surveys carried out in schools and among teachers. A previous version in the form of a policy note stimulated discussion among different actors at a workshop, attended by international experts in February 2002, that was devoted to the topic; the note was edited according to the workshop findings and from discussions with other interested parties.

In its present form, the report embodies the findings of the workshop and the conclusions of the ensuing discussion with stakeholders, together with ongoing analysis and readings in the literature.

**The Reform Agenda**

The global economy is evolving hand in hand with the information society defined above. The process is happening so quickly that individuals will be forced to renew their knowledge and skills repeatedly throughout their lives. Basic reform of education, therefore, should impart techniques for flexible learning that students can apply on their own behalf whenever necessary. The trend in OECD countries makes it clear that “this requires fundamental shifts in formal education and training systems where the focus needs to be on teaching how to learn and how to use information, as opposed to simple transmission of facts” (World Bank, in development). “This does not signify abandoning the traditional goals of Russian education. Academic education should be continued, but its practical and life oriented aspects should be enhanced” (Pinskiy, ed. 2001).

To achieve this, policymakers in Russia have followed the OECD in defining the core competencies with which a student should be equipped on emerging from general education. “Successful participation in the world of work, in the surrounding community and society, and in family and other social fields requires competent individuals. Based on a body of scholarly literature and on interdisciplinary insights, three theory-grounded, broad categories of key competencies have been constructed. The three categories of key competencies are acting autonomously, using tools interactively, and functioning in socially heterogeneous groups.” (OECD 2002, p. 11).

The Russian reform agenda around these competencies has not yet been fully worked out. This is especially the case in respect of the ability to use tools interactively, which was not in the focus of Russian educators.
The following key competencies are relevant when it comes to using tools interactively:

- The ability to use language, symbols, and text interactively:
  This key competence concerns the effective use of language and symbols in various forms and situations to achieve one’s goals, to communicate with others, to develop knowledge and potential. It allows individuals to make sense of the world and to participate in dialogues, and thus to interact effectively with their environment.

- The ability to use knowledge and information interactively:
  This key competence concerns the effective use of information and knowledge. It enables individuals to manage knowledge and information and to use it as a basis for understanding options, forming opinions, making decisions, and taking actions.

- The ability to use (new) technology interactively:
  This key competence concerns not only the technical skills required to use the technology in question – for example, a computer and its software – but an awareness of the new forms of interaction that are possible through the use of technology. This competence enables individuals to adapt their behavior in daily life to this potential.


In general education, reforms are being planned around a shift to modernize the education content and the rationalization (“optimization”) of school networks to respond to a shrinking population. Plans for the latter will include a proposed shift to a formula funding mechanism that will distribute funding through capitation grants – the principle of “money follows student”; it is hoped that this will begin to counter the underfunding that, since 1992, has contributed to the degeneration of the system of education and to the unfair distribution of its availability to different sections of the population.

There has also been progress in reconsidering the chaotic and unpredictable arrangements for measuring student progress and the certification of standards achieved; these, too, have contributed to inequitable access to different levels of education as they became fragmented and distorted with the decentralization of the education system. The Bank has contributed to the development of open certification standards by suggesting the so-called single state exam for entry to the tertiary level of education now being piloted on a regional basis.

**The Likely Effects of Modernization**

Modernization includes an emphasis on students’ independent learning and on interactive modes of learning rather than passive absorption of lectures from the teacher; it includes a curriculum oriented toward learning outcomes. These include both the skills and knowledge acquired by the student and the social and economic effects for students and society. The intention is to counterbalance an existing emphasis on so-called inputs that range from the current style of teaching to a focus on a narrow technological discipline.

In IVE, reforms should be focused on the needs of a knowledge-based economy. The introduction of core work-based groups of skills (including computer literacy) and the development of curricula for the “new” professions – many of which require advanced information technology (IT) skills – are high priorities; Russian education is not currently equipping students to meet those priorities in either of the two educational streams: the general or the initial vocational.

It is clear that the changes to the curriculum will also have an important effect on the daily life of students and the teachers and on the culture of the school environment. As the use of ICT accelerates in schools
ICT will affect the minutiae of school life such as timetabling and will even affect how teachers are paid as time in front of the whole class becomes less important and teachers spend more time on mentoring and tutorials, and on developing and locating learning resources for their students. It will also affect assessment methods that will need to be flexible enough to cover unique individualized learning outcomes. Support will be needed for this progressive transformation of school culture and practices within a shift to preparation for life in an information economy.

The reforms to education will increase the need and demand for ICT skills among both teachers and students; such skills are not all technological, but include aptitudes such as teamwork and problem solving that have not previously been in the forefront of traditional education. Also needed will be hardware, quality learning software, and flexibility in delivery methods. Indeed, recognition of the need and the demand for ICT skills and resources is already growing, having fallen behind after an early start in Russia.

Given this receptivity, ICT could be introduced through reforms already in progress. These include the restructuring and rationalization of rural and urban schools (including IVE institutions), the introduction of core work-based skills in IVE, and curriculum development for “new” professions. These reforms will increase the need and demand for quality software, flexibility in delivery methods, and above all, a retrained teaching workforce.

This report reviews developments, in the context of the three key issues of education reform identified above and discussed below.

FOCUS ON KEY ISSUES

As developed countries have adapted their education systems to meet the requirements of the new global markets, they have tended to address three key issues: ensuring equity of access to quality education, finding new ways of teaching and learning, and building appropriate skills for adjustment to information economies. These countries have found that the use of ICTE can bring major benefits in smoothing the reform process as follows:

1. It can provide greater access to modern education for different population groups, thereby equalizing educational opportunities.

2. It can enhance the teaching and learning process through a variety of means starting with the use of flexible methods of delivery and assessment to foster student-centered teaching. These methods limit the time given to whole class teaching and lecturing to allow teachers to emphasize individual topics with individual students, exploring with them the methods they might use to gather information on such topics. In this way, flexible methods promote greater use of information resources and technologies. Other enhancements include renovating education content to bring it in line with the needs of modern economies and societies; and facilitating improved educational management.

3. It can prepare future citizens for life and work in a modern information society through the acquisition of the required technological skills.
Below we discuss why these three key issues are relevant for Russian education and how they could guide any Russian ICTE strategies.

**Access and Equity**

Bank analysts and operations experts note that access is becoming a serious issue for education systems in former Soviet countries (World Bank 2000A). However this issue is usually associated with enrollment data, which did not change too dramatically for Russia in general education. The total enrollment in IVE decreased but the main reason for this decrease seems to have been that more students chose to continue education in high school after grade nine rather than move to the vocational stream. While this was happening, the number of IVE schools was also decreasing (by 7.7 percent since 1994) changing the proportions of students attending such schools.

The real issue is inequity in the quality of educational services accessible to different social, cultural, and geographical groups. There is a significant difference between different types of secondary schools and different educational streams for the seven-to-seventeen age group (Canning, Moock, and Heleniak 1999). It would be correct to say that there are four major educational trajectories for the seven-to-seventeen age group: specialized school, regular school, vocational education schools after ninth grade of regular school, finish of education and transition to work (or unemployment) after ninth grade. Sociological data show that the distribution of students among these four options reflects the level of their family income. For example, more than 50 percent of students of VE institutions come from working class and low-income families. And this proportion is growing. At the same time the ratio of these students in high school is decreasing (Konstantinovsky 1999).

There is a limited amount of reliable data to confirm that inequality in access is growing dramatically throughout the system (see appendix 1 and appendix 2). However these observations are confirmed by Russian public opinion surveys and in the opinion of professional educators. In recent years, many experts have mentioned the alarming movement of a previously equitable Russian general education system toward a quite stratified and unequal system. About 70 percent of the general public and experts think that the situation with equal access to education is unsatisfactory. They think that this issue is the most important and critical for the future development of Russian education (World Bank 2000B, unpublished). They think that two major determinants of inequality are income difference and city-village inequality.

Inequality of access can occur at the most basic and pervasive level – exclusion from preschool, where the grounding in social skills takes place – and at the level of ICT, when family fortunes determine the extent to which a growing child has day-to-day contact with computers. To the extent that parental poverty is the cause, it is hard to see how it can be overcome in a situation where funding of education is depending increasingly on parental contributions. For example, these can take the form of “voluntary” contributions to school expenses for equipment or of payments for special tutoring by teachers who supplement their meager incomes preparing children for exams that may determine their entry to higher education. Thus income difference can be a determinant of inequality either by excluding a child from education altogether or by foreclosing on the opportunity to profit by it. City-village inequality derives from the comparative scarcity of resources (including ICT) available to rural schools and, beyond the school walls, to rural school children, some of whom may not have the means to travel to school or may be needed to help out at home or in the fields.

Another serious issue is the imbalance in ICT use between boys and girls. In general schools, among boys, 76.9 percent are regular computer users and 37.4 are regular Internet users; among girls these figures are 53.3 percent and 18.8 percent. The situation is even worse in IVE schools where about 30
percent of boys and 19 percent of girls use computers regularly. The figures for Internet use are 15 percent and 1.7 percent, respectively (World Bank 2000B, unpublished).

The issue of access and equity in relation to ICT in education raises two questions:

- Does the introduction of ICT lead to greater access to better education in general and to knowledge in particular?
- Does the introduction of ICT make the access to good education and good learning resources more equal?

In answering the first question we are talking not about access to the ICT per se – we are talking about access to better education through ICT. Nor is it about whether access to computers by itself improves educational performance. This is a misconception that can prove counterproductive, as discussed below.

The second question is related to the notion of digital divide (DD) – a substantial asymmetry between different groups of population in the distribution and effective use of ICT (Wilson 2000). The proposal to use ICT would be not solely to give equal access to ICT but to use ICT to give disadvantaged groups better access to better education for greater social equity.

The second question is critically important because ICT could be more significant for disadvantaged groups (including students from remote areas) than for wealthy and centrally situated groups with a lot of opportunities for access to learning resources and knowledge without ICT. Such access may be especially important for teachers from rural and remote areas where teaching resources are limited. There is a paradox here since the costs of connectivity in remote areas or poor households themselves contribute to the exclusion of the disadvantaged. This is because these costs make the infrastructure of electronic distance education, which has the potential to level the educational playing field for isolated communities, too expensive to install in remote areas.

**Access to Hardware**

Stratification of Russian schools is reflected in the distribution of hardware. Specialized and academically oriented schools (the so-called lyceums and gymnasia) usually attract more children from well-educated and wealthy families. Data confirm that these schools have more computers, copy machines, printers, and so forth, than ordinary schools. For example, our study shows that in Krasnoyarsk, the average number of computers per lyceum and gymnasium is twenty-six while the same ratio for the typical average school is fifteen (see appendix 1, p. 46). Furthermore, lyceums and gymnasia usually have fewer students per school on average than regular schools. The same ratios are true of computers for teachers in that more teachers in privileged schools have computers at home than teachers from ordinary schools, reflecting an income difference. Data show that 62.5 percent of school students’ families with high income are regular computer users while only 35.9 percent of low-income families use computers regularly. On the other hand the higher the education level of a family is, the more time it spends working on computers.

The gap between rural and city schools in the number of computers per school (and per student) was until recently very significant. A recent presidential initiative, *Computers for Rural Schools*, described below, reduced the difference. However, in big cities, access to hardware is better, not just through schools but because of greater access to commercial computer salons, noncommercial extra curriculum clubs (ICT centers), and Internet cafés. Many students use computers at their parents’ work places. Obviously, all these possibilities are very rare in rural and underdeveloped areas and rarity is compounded by lack of awareness among poorer and rural parents.
Another and equally serious gap, or divide, is opening between students attending general and IV schools. To date IV schools have had no federal financial support for acquiring hardware. Not only are IV students unlikely to be able to access ICT at their institutions, they are less likely than their general school counterparts to access computers at home because of their generally lower socioeconomic status. IV schools are already a dead end, in not providing a pathway to higher education, and deficiencies in ICT make a bad situation worse.

**Box 1 Student Access to Computers Compared**

The Krasnoyarsk case study showed that a surprising 30.4 percent of students in eleventh grade have access to computers at home (39.5 percent in urban and 5.7 percent in rural schools). However, only 7.6 percent of students of IV institutions in that region have computers at home (8.4 percent in urban and 2.3 percent in rural IV schools – see appendix 1, table A1.3, p. 58).

**Access to Communication Channels, Information Sources, and Learning Materials**

The gap between urban and rural communities' access to communication channels goes far beyond the difference in their access to hardware. More than 50 percent of all Internet users at the end of 2001 lived in Moscow, St. Petersburg, and the few cities with a population of over one million. Three additional factors compound the problem: bad telephone lines make Internet connectivity in rural areas almost impossible; lack of teachers' awareness about the Internet's potential as a learning tool results in few Internet resources being used even when available; and high Internet service provider costs must be met from extrabudgetary sources. Another potentially serious problem is an anticipated shift to timed local calls.

However, a greater and potentially more difficult problem exists in that if students and teachers have good access to hardware and communication channels, they will find a dearth of good digital learning materials (DLM) in the Russian language, of teaching methodology materials, and of examples of best practice using ICT. Moreover, most existing electronic learning materials are developed for home rather than school use. In general, only students from wealthier families owning computers have access to these materials.

**Box 2 Educational Software Tests Poorly**

In a recent study to identify appropriate educational software for the Computers for Rural Schools program, experts tested 400 educational titles. Only 100 were found to be curriculum relevant and only 27 were recommended for supply to schools.

**Access to Expanded Educational Opportunities through ICT-Enhanced Education**

Despite its vast distances and its many widely dispersed small schools, Russia, has no strong tradition of distance learning delivery for general or IV education (see appendix 1, p. 56 for experience in Krasnoyarsk). However, although distance learning can provide additional support for special groups of students – those in profile schools, those with disabilities, and those who are very brilliant – it is not the main issue; the main issue is the provision of access to education through ICT. This is how the risk of digital divide will be minimized. High priorities for accomplishing such access are to develop materials for teaching and learning that are relevant and modern and to provide teachers with training in their use and encouragement to do so. International experience suggests that such preparation of teachers’ attitudes is critical to the acceptance of ICTE.

Much of the developed world has taken steps toward using flexible learning resources in vocational training to support moves to competency-based training. Competency-based education provides an IVE student with more than just some amount of knowledge and a narrow profession; it provides a set of
competencies or skills that can be used to perform various jobs in different industries. But Russia's IVE has not moved into flexible learning. It is locked out because of lack of distance or teacher-independent learning resources and entrenched attitudes that fail to recognize the value of such resources or delivery methods.

**Access and Equity: Conclusions**

Can the introduction of ICT lead to greater access to better education? The answer is yes but in Russia, to date, lack of quality learning materials and of quality control in the development, production, and delivery of learning materials is hindering this possibility. Can the introduction of ICT make access to good education and good learning resources more equal and socially fair? Although some international experience has shown it to be so most of Russia's efforts to date to embrace ICT in education have only accelerated the widening of a digital divide between wealthy and poor schools and institutions, and between general and IV education students. It is hoped that the recently initiated program, *Computers for Rural Schools*, will mark a reversal of this trend.

Thus, the introduction of ICT has not so far significantly reduced disparities in access to better education between students from wealthy and educated parts of the population and others less privileged. This is partly because of the lack of distance education programs targeted to special groups and the lack of teachers’ and public awareness and partly because ICT equipment is used mainly for technical ICT training in *informatics*. ICT has not yet been sufficiently integrated into the teaching and learning process to increase access to better learning resources or their manipulation. Thus, even the recent small-scale increase of access to the equipment does not really work against social, cultural, and geographic inequality. Existing programs – apart from *Computers for Rural Schools* – do not address the problem of equal access because they are not intended to fulfill this potential of ICT.

As things stand, therefore, there is a distinct risk that the introduction of ICT, used as it is at present, and the development of new content for the Internet will lead only to even greater inequality – to widen the digital divide (DD) in Russia. If the existing gap is not overcome the disadvantaged groups will suffer further, and their educational opportunities will be reduced to the point of their exclusion from modern education. As Castells & Kiseleva (2000) noticed, some territories of Russia could be totally marginalized as a result of the DD.

The most disadvantaged group is students from rural and remote areas (even more then students from poor urban schools). However students from some urban schools and especially from IVE schools need the assistance as well.

**New Ways of Teaching and Learning**

Recent research indicates that the use of ICT to achieve traditional results – acquiring simple information and skills – is not an efficient way to use ICT. Moreover, all experts warn against inflated expectations of what children can learn simply by accessing the Internet or by having computers in the classroom. There is no reliable evidence to support claims that simple access to computers improves learning; indeed, disturbingly, emerging evidence suggests that the reverse is likely. Reasons advanced, include the fact that emerging technology is used poorly; many teachers have not been effectively trained; and there are indirect costs to children, in the form of reduced art, music, and physical education. Despite broad consensus that classroom management and assessment systems are strengthened through computerization, there is also evidence that the finance required to introduce computers to classrooms is much greater than most estimates, which omit the costs of upgrades, maintenance, and training.
Nevertheless, most experts (see for example, Voogt and Plomp 2001; Dede et al. 2000; Zhen-Wei Qiang, and Conley 1997) today agree that introduction of ICT into classrooms by skilled and trained teachers can lead to qualitatively new educational outcomes. The experts cited above mention, among others, the following outcomes:

- A shift from lecture and recitation to facilitation by the teacher – strengthening opportunities for independent students’ learning
- Creating possibilities for more flexible and adaptable learning pathways for individual use
- Facilitating reflective inquiry through extended projects generating complex products
- Increasing access to unlimited information sources
- Creating possibilities for mastering transferable ICT related skills
- Fostering success for all students regardless their special needs
- A shift from a competitive to a cooperative social structure of learning.

Is Russian education ready to move in these directions? Most of these changes are in line with the current strategic directions of Russian education, and there is much public support for change. But Russia's teachers, dedicated but poorly paid, may prove resistant to change, despite the enthusiasm of many of the younger ones. So far, indeed, these important shifts are slow in coming. Despite the number of innovative practices introduced of late, general school practice remains the same as it has been for years. Whole class teaching, lecturing, and individual tasks based on textbooks are still the predominant forms of teaching in Russia. Telecommunication projects and independent work with digital sources of information are not widely used although they have been shown to have great potential for Russian students.

Among a number of reasons, the most important is that the existing system of student assessment, textbook design, and learning management does not require innovative teaching methods. Even where access to the Internet is available, the majority of teachers are not yet encouraging their students to use it as a research tool for their projects. To date, policymakers have not targeted ICT to promote innovative practices in pedagogy, and according to our interviews, there are very few examples of the use of ICT to provide greater flexibility and individual learning pathways.

A further significant barrier to innovation is the difficulty of obtaining quality learning materials and the obstacles to their creation. No modern reliable quality assurance systems are in place for new e-learning materials. There are no enabling regulations regarding copyright and intellectual property, and no common means of disseminating information about materials already developed or any means to share them. Nor is there any channel for feedback to DLM developers to enable the developers to know teachers’ and students’ real needs. Russia has a chronic shortage of skilled instructional designers resulting in learning materials that are technologically rather than educationally focused, and that fail to take full advantage of ICT’s interactivity potential. There is a crucial need to develop guidelines for producing learning materials of good quality.

Russia has just started to develop mechanisms for assuring the quality and appropriateness of e-learning materials. However, the 1992 “Education Law” regulating all activities and relations in the Russian education system is silent on the question, despite continuous modification of the law since its original passage. Currently, producers of educational e-products decide independently whether their goods need certification; and some decide against. Many entities currently provide different versions of certification. Among these are a special section of the Federal Expert Board (under the supervision of the Ministry of Education); regional expert boards; initial and secondary vocational education expert boards; and special councils within HEIs. These organizations issue certificates according to their own rules.
In IVE, as always, the situation is worse: no e-learning materials at all have received the Ministry of Education's recommendation. Moreover, teaching methods and curriculum policy for IVE remain more conservative than in any other branch of Russian education.

Thus, the introduction of ICT is seen as a very important catalyst for reaching one of the strategic goals of Russian education reform: increasing the individualized character and flexibility of the learning process. The Russian Ministry of Education has announced the introduction of a flexible curriculum in the final years of schooling whereby individual students can adjust the profiles of learning plans to assume higher levels of learning than the minimum required by the curriculum structure. The aim is to provide diversity in curriculum opportunities. However, given the rigidity of the existing learning organization, those goals will be very difficult to achieve. The problem will be more acute in rural schools where choice of subjects is naturally very limited because of student numbers and the availability of subject experts. Appropriate courses and modules supporting ICT assisted and/or distance learning could do much to overcome such limitations.

**Teaching and Learning: Conclusions**

ICT as introduced today has not yet become a catalyst for important change. However, the widespread use of ICT in education could support Russia's current educational reform agenda, which includes the following: the development of learning outcomes appropriate for citizens in an information economy, student-centered practices, changes in teaching methodology, education content renewal, curriculum diversity, and development of flexible organizational forms. Moreover, it is difficult to see that these goals can be practically achieved in a timely manner without such support.

**ICT Literacy and Advanced ICT Skills Development**

The most obvious justification for introducing ICT into schools and IV institutions is that students should master ICT to be productive in a modern economy. This means that one of the outcomes of introducing ICT into education should be mastery of ICT related skills, attitudes, and knowledge. It can be achieved on two levels: universal computer literacy and advanced technological skills.

In general education schools in Russia, the emphasis remains on programming skills. This practice goes beyond what most students need. It equips all students with skills most do not need in their future work and often alienates them from making use of ICT. There needs to be a shift to basic user competence for all students. In initial vocational schools, the same is true, but there, informatics is taught at the expense of vocationally oriented ICT user skills.

The need for courses in advanced technological skills to ensure a skilled IT workforce for Russia remains, but these courses should not be mandatory for all students. Basic universal computer competence should be.

**Summary of Key Issues**

Use of ICT in realizing all three goals of education reform (equalizing access to quality education, improving the quality of teaching and learning, and providing ICT skill training) is very relevant for Russian education. None of these three goals is explicit enough in policy documents or in the E-Education and E-Russia programs’ performance indicators. The means of achieving all three are interconnected. It would be beneficial if all aspects of ICT in education strategy could be reviewed from these three standpoints. The most urgent issue is the first – equality of access. The digital divide is growing in Russia: new policies and programs must ensure that they do not foster that growth. The
second goal is the most challenging: use of ICT in support of the provision of new ways of teaching and learning to achieve new learning outcomes suitable for application in a new kind socioeconomic environment.

THE SITUATION TODAY AND ITS BACKGROUND

Paradoxically, Russia under the Soviet Union, was an early entrant in the field of information and communication technologies. As early as the middle sixties, the Soviet government recognized the important role they would play in international communications, including trade, and hence in education. The country started to develop its own electronics industry and placed its own computers in Soviet schools.

Russia's efforts stalled in the last few decades because of its economic problems. As a result, much of the information technology revolution of the last decade passed Russia by, and the computers it placed in schools are obsolete; however, many remain in place, thus creating misleadingly low ratios of students per computer. Now, with recent improvements in both economic and political stability, the Russian government is seeking to catch up. Active discussions are taking place on Russia's need to move rapidly toward an information economy. This movement is marked by the two ambitious federal programs mentioned in the introduction: Development of the Common Education Information Space for 2001-2006 (E-Education) of August 2001 and Electronic Russia for 2002–2010 (E-Russia) published 28 January 2002. These programs aim to create "conditions for building an effective well balanced economy focused on domestic consumption and export of information technologies and services" (E-Russia). As also noted earlier, their common strategy includes the acceleration of the introduction and integration of ICT in education (ICTE). For the first time higher education is not the exclusive focus of attention: Russia has recognized the urgent need to embed ICT in its educational practices in both general and vocational education. This report supports the development of a national strategy for ICT integration into general school education and into initial vocational education (IVE).

These goals have been strongly supported by President Putin in the context of his vision of a modernized Russia. While noting in a speech on 24 June 2002 that the Russian education system continues to be one of the best in the world, he stressed the importance of adjusting it to modern conditions: "If we wish the system to be viable, we should work for it, should take corresponding measures.” In support of this viewpoint, he has personally lent weight to two initiatives, discussed later in this report, for installing computers in urban and rural schools.

The Bank and Russian Education Reform

The Bank’s involvement with Russian education reform began in the mid-1990s, when the government became aware of the threat to the Russian education system posed by the underfunding of decentralized education management. Increasing economic problems had led the federal government to turn policymaking, management, and to a large extent, funding over to the regions. However, the regions’ own resources were limited. Their resulting inability to maintain infrastructure, let alone standards, were threatening the consistency and equitability of the system and, therefore, its availability to all. The resulting endangerment to Russia’s educated work force became apparent at about the same time as did the need for its continued existence to Russia’s participation in the world market economy.

The Bank’s first education project, the Education Innovation Project, approved in April 1997, provided support to the reform of textbooks and limited support for tertiary education. A report, Reforming Education in the Regions of Russia (Canning, Mooock, and Heleniak 1999), born of the recognition that
higher education had to be founded on sound beginnings at the primary and secondary levels, analyzed general and initial vocational education. This report informed a second project, the Education Reform Project approved in April 2001 with the objective of piloting reforms in three regions. This project gave no significant role to ICT. But by this time, the inevitability of electronic networking and the exchange of information in linking societies and economies worldwide were clearly apparent. Now, improving fortunes allowed the Russian government to consider reviving the early Soviet efforts to develop ICT for domestic internal management and for participation in world markets; the Bank was asked to report on the potential for integrating ICT into the on-going educational reform – the so-called “informatization” of teaching and learning. (“Informatization” translates from the Russian as the “introduction of new information and communication technologies.”)

This meant going beyond the informatics courses, already present in the curriculum, which train students in the techniques of programming and computer management. The purpose of introducing the new communication technologies into education would be to incorporate the use of the communication potential of computers into the new classroom methods of teaching and learning. These methods emphasize the autonomy of pupils in researching new subjects, exchanging information, and solving problems. They are designed to provide students with competencies in collaborative methods of work that could be applied outside the classroom, particularly in the labor market. The government recognized that classroom methods would have to incorporate ICT like any other mode of communication in the professional and working world.

Russia’s Digital Experience in Education

As noted above, Russia under Soviet rule had recognized the importance of computer technology as early as the middle sixties. At that time, it was introduced into schools, and computer science courses were being conducted on a pilot basis. By the mid-eighties, informatics as defined above had become a compulsory course in the Soviet curriculum and was taught to all students, even when in some schools no computers were available. At the beginning of the nineties, up to 28 percent of schools were equipped with computers, mainly of Soviet make – for example, Agat, BK, and UKNT. Special software was developed and teachers were trained. The purpose of introducing computers into general education was to achieve a technological breakthrough for the USSR through development of information and computer literacy in all general school graduates.

Neither the USSR then, nor Russia since, was able to sustain these pioneering efforts. By the late nineties, Russia had become the only country with an increasing student to computer ratio, a situation caused in part by the obsolescence of the first generation computers installed in the eighties.

Box 3 High Percentage of Computer Classes Have Outdated Equipment

In 2000, in the Ulyanovsk region, more than 80 percent of the 105 computer classes were equipped with outdated computers (bought in the eighties). The total number of computers had decreased by 18 percent compared with 1999.

The decentralization of the Russian education system in the nineties resulted in a growing inequity of ICT availability across the education system. For a number of poor regions, simply equipping schools with hardware is still the priority. Only some of the richer regions are at the next stage of embedding ICT in educational practices. Most rural regions of Russia are digitally divided from their richer neighbors in cities.

Limits to Investment in Russian ICTE
During the nineties, the only significant forward movement in the use of ICT in education was seen in the higher education (HE) sector. For the most part because of the division of responsibilities for education between regional and federal levels, any federal funding available for the purchasing of hardware went to higher education institutions (HEIs). The push was uncoordinated, and had no clearly recognizable and coherent strategy for changing either educational content or methodologies. It led to such a degree of diversification in technical specifications and software standards that it closed the door to any subsequent systemwide approach.

An ambitious federal targeted program in the field of distance education was developed by 1995, but it received no federal government financial support despite its correspondence to main international trends. Lack of coordination springing from the involvement of multiple players (including several federal ministries) was also evident in the setting up of a national telecommunications network for the Russian science and higher education system in 1995. This significant technical capacity was developed without considering either the need to develop accompanying learning resources or the possible use by other levels of education. Meanwhile in 1996, the Open Society Institute (Soros Foundation) mounted a significant initiative (R513 million, or US$17.1 million),2 associated with this science and higher education telecommunication network. It was aimed at creating Internet centers with public access in thirty-three provincial universities. This project has resulted in wonderful gains in access; however, even greater gains would have been possible had the initiative been more closely integrated with other Ministry of Education programs.

The net effect is that investment in ICT in higher education in Russia has had very few flow-on effects to other levels of education and has generally been at their expense.

The numbers compare very unfavorably with those of OECD countries and even some developing countries. At the beginning of 2001, Russian schools had one computer with a modern interface for every 500 students.3 In many European countries, this ratio is one computer per 10 to 15 students. In this regard, Russia in 2000 was far behind not only other G8 or OECD countries but also many countries of South Asia and Eastern and Central Europe (appendix 4, p. 103). Emerging data suggest that there has been a significant improvement in these ratios over the last two years. It may be inferred that this improvement has occurred partly because of the rural and urban schools' computerization programs, under which more than 131 thousand computers were installed to Russian schools improving student per up-to-date computer ratio to 113.

The problem extends to software, networking, and Internet access. For the most part, any available licensed software operates only on early generation computers while unlicensed software abounds for newer computers. Less than 3 percent of schools are networked and only 1.5 percent of them have access to the global information network. Russian-language electronic learning resources are being developed extremely slowly and are unremarkable in quality.


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<td>9.71</td>
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<td>USD / RUR</td>
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<td>0.103</td>
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3 Statistical data in the report are not all official education statistics; they were received from different sources but considered reliable by experts. Statistics received from different departments of the Ministry of Education can vary for the same indicators.
Planning for human resource development in ICTE is lacking. At present, less than 20 percent of schools have full-time computer technology specialists, the ratio being one specialist per 1,500 students. At the instructional level, teacher training has been focused on the teaching of informatics as a special subject, a skill that is not readily applied to the teaching of general subjects. Teachers of general subjects, meanwhile, are largely untrained for the task of using computers or the Internet in their teaching practices. The situation in initial vocational education is far worse in all respects. For the most part, IVE remains the fiscal responsibility of the federal government and to date there has been no federal funding forthcoming for the systematic introduction of ICT in IVE.

Russia’s recently improved economic and political stability is changing the picture. Russia can now afford to recognize the urgent need to embed ICT in its educational practices in both general and vocational education. As mentioned above, the common strategy of the two policy programs, E-Russia and E-Education includes the acceleration of the introduction and integration of ICTE

Federal Policies and Programs for Improvement

The E-Russia and E-Education programs are two of several major policy initiatives related to ICT that have been launched by a government motivated by President Putin's declared vision of a modernized Russia. They are critically important for ICTE program development and implementation in its catalytic role in education reform. These federal government programs are complemented by several large-scale private sector programs still being worked out, but aimed at teacher training, Internet portal development for education, and satellite educational TV.

The federal policy initiatives are perceived as a key condition for integrating Russia into the community of developed countries and are taking place in an environment conducive to change. Social assessment surveys conducted for this report have indicated a positive change in the public's attitude toward ICTE as well as a growth in support by school administrators, teachers, and parents. ICT-related programs have strong support from all sides of the Duma.

Programs Initiated by President and Government

Programs have been initiated at both the federal and regional levels.

Federal programs. The cornerstone of the government's ICT thrust is the R77.18 billion program mentioned above, Electronic Russia for 2002–2010, known as E-Russia. Its intention is to increase the efficiency of the economy in both the public and private sectors, to make wider use of information technologies in government departments, and to transfer much of the state's work on-line. The program addresses four key areas: (1) regulatory and legal environment, (2) telecommunication infrastructure, (3) e-government, and (4) e-education. The main thrust of the e-education component is ICT-related human resource training.

The plan to connect all towns with a population of over 30,000 to the country's fiberoptic backbone should dramatically increase the number of Internet users in population centers; however, rural Russia could still remain isolated because of poor telecommunications infrastructure.

Conceptually and technologically linked to the E-Russia program is the E-Education program for 2001–2005. This program reflects the widening of government attention to all levels of education, including general and initial vocational education. The program aims to establish an information technology infrastructure in the education system by providing educational institutions with computer equipment;
access to global data resources, general systems, and applied software; and maintenance services. The program includes plans to integrate ICT in the Russian education process through the introduction of standardized and certified electronic learning and training materials; it is also designed to ensure training of teachers and administrative, engineering, and technical staff in the efficient use of advanced information technologies. For 2002–2005, the program will cost R56 billion (US$1.9 billion), including R16 billion (US$533 million) from the federal budget, R22.4 billion (US$747 million) from budgets of the subjects of the Russian Federation (the regions), and R17.6 billion (US$587 million) from extrabudgetary funds.

President Putin has supported two programs for equipping schools with computers and related equipment. First, in 2001, the Ministry of Education invested one billion rubles in computer equipment for rural schools in eighty-four regions (out of the eighty-nine) on a ruble-for-ruble arrangement with the regions. This is the Computers for Rural Schools program. As a result of open tender, 30,715 rural schools (96.8 percent of the total number of schools eligible for the program) received more than 76,000 units of ICT equipment, including 56,500 computers. Each school also received a special set of CD-ROMs of the best Russian education software available. More than 10,000 teachers from rural areas received additional training. The program is expected to have far-reaching benefits for rural children but unfortunately does not appear to have a built-in system of indicators for evaluating program effectiveness.

The second program is to equip urban schools. This plan is covered in the 2002 federal budget with R2.1 billion aimed at putting one computer class (10+1 computers) into about 8,700 urban schools. Federal financing is 40 percent of the total with 30 percent coming from regional and 30 percent from municipal level budgets. This is the Computers for Urban Schools program.

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<th>Box 4 Rural and Urban Student to Computer Ratio Improved</th>
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<td>As a result of implementing the Computers for Rural Schools program, the student to computer ratio in rural schools of the Krasnoyarsk region has improved from 193 to 51 students per up-to-date computer. And the Computers for Urban Schools program has significantly improved the situation in the Krasnoyarsk region urban schools, bringing the student to computer ratio from 188 to 46 (see appendix 1, p. 45).</td>
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The programs discussed above are the main ICTE initiatives sponsored by the government. One other Ministry of Education initiative of potential significance to general schools is the development of a system of educational Internet portals with a linked federal bank of digital education resources. In effect, this combination will create a systemwide electronic library.

Both programs, E-Russia and E-Education, are interrelated. But there is no clear mechanism for their administrative coordination. Nor have the implementation arrangements for the E-Education program been defined yet.

Regional programs. During the last five years regional administrations have realized that they could not wait for significant support from the federal level in the area of ICTE. Accordingly, many regions developed their own ICTE programs using a variety of approaches. These programs include equipping schools with computers, connecting schools to the Internet, teacher training, and so forth. Some of them were developed together with other public sectors. However, lack of finance and expertise has reduced the effectiveness of these programs, which, in the absence of a federal strategy, were also uncoordinated with each other. Analysis of some regional programs is provided in appendixes 1 and 2.

Private Sector Initiatives
Three private sector initiatives are of note. They all mark interesting developments although they are not always of direct relevance to general school and IVE needs.

**Yukos Teacher Training Program**

In 2000, the Yukos oil company established a Federation for Internet Education and started project Generation.ru funded at R1.4 billion over five years. The main goal is to introduce Russian teachers to ICT in general and to the Internet in particular. Internet education centers will be open for five years in fifty Russian regions to give training to over 250,000 teachers in the use of ICT and Internet technologies in the education process. It is claimed that, as a result, more than 10 million school students will be taught to work on the Internet. Yukos provides funding for tuition, transport, accommodation, and lunches. The regions are cofinancing the project by providing premises and paying for some of the running costs. This is the first significant private sector charitable initiative in this field. The Ministry of Education has established strong cooperation with this project and is trying to use it to increase the effectiveness of the Computers for Rural Schools program.

It is expected that this program will directly benefit general education. International experience suggests that those teacher training programs that rely not only on short “sandwich courses” but on ongoing support for teachers have better long-term outcomes. Chile, for example, has developed a similar program of microcenters where teachers could come on either a structured or an informal basis for training or for sharing of ideas. Monthly meetings have provided valuable opportunities for reflection about the way to introduce technology in the rural classroom (Hepp et al. 2002). Sri Lanka is offering ICT courses to untrained teachers through its Institute for Distance Learning supplemented with face-to-face sessions at regional centers and through study circles with other regional teachers (Tatto et al. 1991).

**Auditorium.ru Portal Initiative**

This Internet portal was founded by the Open Society Institute (Soros Foundation) in 2001. The cost of the project is estimated as R299 million (about US$10 million). Its goal is the support of education and science in the social and humanitarian field by improving the accessibility of education-related information through the use of IT. It will create a complex database of digital resources and provide free public access to the database via the Internet site www.auditorium.ru. Although the project is focused on higher education, one of its most important effects will be to overcome inequity between Russian regions in access to information. However, the portal is not yet fully operational, and it does not yet give a full impression of a system of education even for the university sector and scientific community, which the designers have identified as the target audience. Nor is this initiative yet linked effectively with the Ministry of Education programs or with “E-Libraries” – an interministerial program to digitalize essential resources – although it is hoped to make it so.

**The Teleschool Project**

Teleschool (http://www.teleschool.ru/faq.html) is a Moscow-based nonprofit education institution with great potential for a possible distance education system. It is intended to offer education services to tenth and eleventh grade students via satellite television. The education process is based on TV learning materials coordinated with standard textbooks and the cost per student is US$500 or about R14,500 per year. It will also be set up to offer state diplomas of general education. Although promoted as a service for remote students, Teleschool management acknowledges that the main audience is students from Moscow. In the year 2001, there was, as yet, no regular teaching in progress, as the main task is still to develop a full course of study on videocassettes and to digitalize them. The potential of this project for
possible distance education system has been noted. However, its clear commercial direction could be an obstacle to its use for equal access purposes, because of its cost for low-income students.

**Public Support**

There is a clear change of attitude toward ICTE in Russian society. The general public understands the importance of ICT. About 40 percent of the population assesses the use of ICT in education as unsatisfactory, and more than 65 percent of experts consider it a necessary innovation for Russian education. General public opinion, considers the introduction of ICT as one of six priorities for Russian education, while those respondents who want to increase the quality of education make mastery of ICT one of three priority directions for lifelong learning (World Bank 2000B, unpublished). Parents include the presence of ICT in the list of “good school features,” and in many schools, parents’ committees help schools to raise money for equipment.

School administrators, teachers, and the teachers’ union also now see ICT as an important part of the reform agenda. This is comparatively recent. In 1993, only 3 percent of teachers indicated that they saw ICTE as a priority for education reform. In 2000, this number increased to 37 percent (Sobkin and Khlebnikova 2000). Those younger members of the profession who remain in teaching are full of enthusiasm and devote a lot of energy and skill to improving the situation and trying to use limited resources in the most effective way. In the absence of good Russian software, some teachers have developed their own programs and approaches.

All political parties have acknowledged the importance of ICTE. An influential faction in the Duma, the Union of Right Forces has initiated a project – *Internet to Schools* – to encourage investment in Internet connections for education by local politicians and businessmen.

**Barriers to Effective Introduction of ICTE**

Despite the emergence of highly relevant government policies and programs, public support, and Russia's natural wealth of talent, Russia faces huge difficulties in equipping its people with the skills necessary to compete in an information economy. Russia's huge landmass, thinly spread population, lack of available finances, and regional diversity all bring daunting challenges, especially to the setting up of effective connectivity and digital networks.

There are also education-related hurdles to overcome. National ICTE strategy development is hampered by a lingering input orientation whereby progress is measured by indicators such as student-to-computer ratios and bandwidth rather than student learning outcomes or social and economic effects. Serious coordination problems, a lack of reliable education statistics for program preparation, and inadequate regulatory frameworks also need early attention. In the last resort all these obstacles hinder the orientation of students to lifelong learning that is such an important objective for educational reform.

All these important barriers to the effective introduction of ICT in general and initial vocational schools are discussed below. But of them all, two are the most important. They are, first, weak coordination of effort and programs caused by the divergent thrusts of institutional and sectoral interests; and second, a restricted vision of the possible impact of the introduction of ICT – adherence to a focus on technological inputs rather educational outcomes. The latter we address first.

**Input Orientation**
The *E-Education* program emphasizes the inputs of funding and equipment but is vague about expected outputs of student achievement. It is silent about learning-related outcomes. For example, the only concrete figures stated as objectives are the following: (1) the reduction of the computer-to-student ratio to one computer per 80 students; (2) the provision of higher education institutions with access to global information resources through high speed channels (256 kbs); and (3) the provision of network access for 50 percent of schools and 70 percent of vocational education institutions. Desirable as these goals may be, such an orientation toward inputs rather than outcomes can lead to a situation in which the ICTE programs become not demand driven but driven by different lobbyists, from university rectors to telecommunications providers. In addition, there is a risk that the top-down nature of the *E-Education* program will exclude valuable grassroots initiatives.

**Coordination**

**Box 5 Work on ICTE Materials and Methodology Overlapping**

| There are currently at least twelve independent state organizations doing similar work on e-learning materials development and certification, telecommunication project support, and ICTE methodology development in isolation. All these organizations receive funding from different Ministry of Education programs. |

There is a variety of potential coordination problems. For example, *E-Russia* and *E-Education*, will have no clear mechanism for their administrative coordination until the interministerial board for the introduction of ICTE created.

There are several potential coordination problems. For example, *E-Russia* and *E-Education*, will have no clear mechanism for their administrative coordination until the interministerial board for the introduction of ICTE, created within the Ministry of Education in December 2001, is up and running. As a result, the *E-Russia* telecommunication infrastructure could be developed before it has the necessary information to make it adequate to the demands of the education network, and these could be considerable.

Networks already include such heavy users as centers of new IT, the university telecommunication network RUNNet, and regional informatization centres. There may be duplication of effort when the functions of old structures, created mainly for the universities and telecoms overlap with the functions of new structures created under the rubric of *E-Russia* and *E-Education*. Without adequate planning, investment in ICT specialist training could be insufficient to cover all levels of education, reviving the danger of program management being concentrated in higher education institutions at the expense of general education and IVE.

Implementation of the different policy programs could also create coordination problems. Each tends to have its own executive body and expert committee for the evaluation of different proposals, the financing of which is distributed separately by different ministry departments. The resulting fragmented financial flows have to be coordinated with each other and with financing from other (nonbudget) sources. Coordination by different implementation agencies presents similar problems.

**Lack of Consensus on Direction**

One of the main obstacles for ICTE strategy development is a lack of consensus about future directions for the overall development of general and, in particular, of initial vocational education. The situation is exemplified in the lack of standardized terminology used in policy, strategy, and implementation documents. The documentation of different but related programs uses the same words with different meanings, creating confusion and barriers to cooperation. The situation is compounded at the federal level by an absence of reliable ICT-related statistics with which to inform policy decisions.
**Lack of Preparatory Analysis and Research**

A disturbing feature of the recent ICT-related policies and other programs is their seeming lack of preparatory analysis and research, including lessons learned from earlier programs. Some reasons are the absence of adequate statistics and a tradition of using them, and a lack of effective and timely evaluation of programs. For example, there appears to be no analysis of the effectiveness and lessons of earlier related programs such as those concerning communication infrastructure or “electronic libraries.” They are mentioned below as a government project developing Internet portals for education (see also appendix 1). Preparatory analysis of the social impact of ICTE programs is also missing.

Nor do these programs appear to take into account lessons from international experience. Of these, there are innumerable examples from the United States alone, including material that measures the effectiveness of ICT. This material includes one case where, counterintuitively, middle school children outperformed high school physics students; researchers concluded that the software made science interesting and accessible to a wider range of students than was possible using traditional approaches. Other examples of useful data range from reports of MIT’s experience in putting course content on line to measures of teacher quality and student achievement in the National Association of Secondary School Principals Bulletin. Without such knowledge, Russia will risk either reinventing the wheel or repeating avoidable mistakes already made by other countries. Examples quoted in this paragraph and elsewhere come from a World Bank report currently under development, *Lifelong Learning in the Global Knowledge Economy*.

Lack of preparation can lead to costly mistakes in the provision of hardware and software in programs. Planned timing and phasing in of implementation are critical. Teacher training, availability of useful computer-based learning software, and budgetary and maintenance support programs need to be in place by the time hardware is provided. Otherwise the hardware can be out-of-date or even inoperable before the rest catches up. The result can be wasted capital outlay and equipment used only for noneducational purposes. Unfortunately, some of this has already happened.

**Institutional and Fiscal Obstacles**

In the past, Russia has suffered from constrained institutional perspectives that make cross-sectoral and cross-level cooperation difficult to achieve. These are compounded by tensions generated by the complexity of fiscal responsibility for the various levels of education provision. The new ICT-related policies show little evidence of any integrated cross-level approach to the introduction of ICTE. Even with the current and proposed programs, schools will lag well behind the higher education sector in ICT implementation, and IVE will be even further behind. Despite the recent ministry statement that IVE would be a priority in the process of modernization, IVE receives little mention in any of the current federal ICT-related programs.

**Regulatory Obstacles**

**Box 6 Copyright Law Lags Development and Distribution of Digitalized Texts**

*The goal of the interministerial “E-Libraries” program was to digitalize essential learning resources. This program (funded from 1997) has not yet been evaluated; however, Internet statistics show that the most popular site, featuring free digitalized texts, is the so-called “Moskov’s Library”. This was created by an individual without government funding and represents the significant effect private initiative can have. This, in the form of individual ideas and enthusiasm, is a resource that has been neglected in recent programs. It is also an indication of the legal pitfalls that can await such an enterprise in an evolving commercial environment. It is uncertain what Mr. Moskov’s copyright obligations may be, and he may*
need help with copyright clearance as he uses digital information resources whose status under copyright law still has to be determined.

Existing regulatory frameworks do not encourage the effective use of ICT in education. This is because Russia’s centrally regulated curriculum does not include provision for ICT to be used in conjunction with academic courses. Despite all schools teaching ICT as a separate subject called *informatics* (in some cases without modern computers or without computers at all), it is still not a fully recognized part of the compulsory curriculum and its educational content is an issue. In IVE, around 90 percent of institutions offer computer classes, and yet recently adopted standards for IVE do not reflect the necessity to use ICT even in training for the twenty-five occupations (from the standard list) that specifically require ICT skills development. Because schools do not get regular financial support for ICT related expenses, difficulties in financing equipment maintenance and supplies are ongoing problems.

**Limited Private Sector Involvement**

The logical source of help for IVE would be the private sector because of its interest in the type of skills that can be developed in a vocationally oriented school environment. However, access to private sector resources by schools has been limited by the obligation of the private sector to pay taxes on such gifts. A possible change in the law may give private enterprise an incentive to give ICT equipment to general or IVE schools.

### POLICY OPTIONS AND RECOMMENDATIONS

This section summarizes recommendations on further strategy development for the effective use of ICT in general and initial vocational education. Taking the previously noted problems into consideration, the aim of the section is to put forward a set of principles and approaches to guide the complex tasks ahead.

The recommendations fall into five areas. They focus first on ways to achieve effective management of an ICT strategy for education and secondly, on efficient use of public resources within the implementation of the strategy. They then specifically refer to the integration of ICT into the three major goals of education reform: improving equal access to modern education services; improving the quality of teaching and learning; and strengthening skill development – with ICT as one of the skills to be developed.

**Recommendations: Policy Development and Strategy Management**

This section focuses on achieving an effective ICT management strategy for education and for efficient use of public resources.

**Goals and Strategy**

*The Ministry of Education should orient the ICTE strategy toward outcomes relevant to E-Russia’s social and economic program, ensuring cooperative links with participating agencies and other programs in the area of ICT.*

The introduction of ICT in education should be promoted as a means of achieving the government's priority goals for education modernization in support of creating a modern information economy. The potential of ICT to assist in achieving these goals should be defined through research and evaluation. The
introduction of ICT should be incorporated in the reforms currently in progress. These include the following: rural school restructuring and rationalization of urban school networks (including IVE institutions); introduction of core work-based skills in IVE and curriculum development for "new" professions; introduction of specialized upper secondary school; introduction of unified national exam for secondary school leavers.

It is essential to coordinate systemic planning, including linkages between the implementation agencies of the E-Russia and E-Education programs, in order to avoid the risk of further fragmentation at national, regional, and sectoral levels.

This strategy should take full advantage of lessons learned from international experience in ICT strategy development and implementation – including both what to do and what not to do. For example, governments all over the world have tackled coordination questions arising from new education policies, some by restructuring central ministries such as Germany’s combined Federal Ministry of Education and Research and Japan’s Ministry of Education, Culture, Sports, Science, and Technology. However, the attempt by both the United Kingdom and Australia to combine their education and economics ministries was reversed. (See World Bank, under development.)

Take full advantage of preparatory analytical work including social impact studies, and analysis of lessons from international experience in ICT strategy development and implementation

Specific groups should be targeted for the introduction of ICTE; advantages, benefits, and risks posed for each group should be pinpointed. These assessments should be based on comparative analysis of the positive and negative lessons learned from introducing ICTE in education in different countries. This should be part of research and development in the field of ICTE particularly in the areas of curriculum, learning materials development, methodology, and assessment.

Balance the tendency of programs to define inputs (number of computers, speed of Internet connection, teaching) with an orientation toward outcomes, primarily learning outcomes.

Programs for integrating information technology into education should be driven by economic, social, and educational demands, not by supply. Clear procedures for measuring impact in terms of improved learning outcomes should be established as a priority. This is vital.

At the same time, the measurement of inputs is also important in order to gauge their correlation with outcomes. There is an urgent need for such a set of indicators and they should include, for example, the availability of ICT in schools and IV institutions, students' access to ICT, and students' actual use of ICT.

**Regulatory Framework**

Revise and strengthen the regulatory framework related to the use of ICT in education

- The following are critical areas needing attention:
- Copyright law to cover development of on-line learning materials
- Intellectual property rights protection
- Development of occupational health and safety standards (radiation, ergonomics, repetitive strain injury)
- User protection against inappropriate materials on the web (censorship/filtering)
- State standards for learning outcomes in fields related to ICT and to development of ICT skills
- Removal of disincentives for private business to support ICTE initiatives
The legal status of existing programs of distance education in both general and IV education (including certification)

- Reorganization of teaching workloads and school management arrangements, including the appointment of an ICT coordinator, to allow for flexible, cooperative learning management using ICT.
- Revised standards for writing off ICT equipment
- Opportunities for teachers to acquire old ICT equipment for personal use
- Development of standards for financing the running cost of ICT equipment and supplies
- Revised standard for remuneration of teachers incorporating ICT in their teaching methods
- Incentives for private sector contributions to ICT in education
- Commercial production of quality e-learning materials

Define responsibilities for the introduction and use of ICTE at federal, regional, local, and institutional (school) levels. This will enhance coordination of public involvement in education and the action of government agencies.

It is critical that ICT strategy development should provide strong links between coordination efforts at the federal level and practice at decentralized levels; it should also provide strong support to grass roots movements and their networking. Recognition and dissemination of best practice; setting up of regional demonstration schools chosen as sites of ICTE excellence; and the provision of grants to support ICT related activities initiated and conducted by schools should all be explored. The ICT introduction programs in higher education and in general and IV education should be coordinated and integrated where possible.

An analysis of current federal and regional responsibilities for introducing ICT and a study of regional programs for introducing ICT to education are both needed. The goal is increased regional responsibility for ICTE programs but with policy coordination exercised at the federal level.

Cooperation among regions with varying degrees of expertise in producing educational software and teacher training provision could reduce costs through economies of scale. See, for example, the opportunities in Krasnoyarsk and Irkutsk described in appendixes 1 and 2.

Cross-level Cooperation

Support the creation of community-based ICT centers

International experience has proved the effectiveness of ICT centers (community telecenters) in serving schools, vocational schools, teachers, and adult and community groups. “The services offered range from basic telephony, fax, and email to full Internet connectivity and even, in the case of World Bank supported Global Development Learning Network centers, full multimedia connectivity and interaction” (Farrell 2001, box 3.20). Such centers can provide greater access to ICT for students from nonelite schools and can foster new teaching and learning practices. In Russia, such centers could be created, in cooperation with the Ministry of Communication and Ministry of Culture, to include local libraries, perhaps by means of community intranets (see Connectivity and Equipment below).

Internationally, the use of these centers for continuing education has been found to be a key factor in gaining community support and in maintaining financial sustainability. Russia already has some successful models, including one in Irkutsk (see appendix 2). But such centers are unrecognised within the system and hence there has been little dissemination of successful experience. International experience can inform Russia's decisionmakers about operating models, sustainability and ownership

With appropriate connectivity, such centers could also become local distance learning centers providing access to systemwide accredited learning resources and to the acquisition of ICT skills. In this role they could create new learning experiences and work significantly toward increasing equity of access. They could also be used for in-service teacher training and/or as community ICT learning centers. As such, they could also be used as showcases and dissemination points for best practice, as suggested below in the section on efficient use of resources.

**Essential steps in introducing ICTE**

*The essential steps and sequence of tasks in introducing ICT in Russian education should be determined and followed. They should have clearly defined outputs that are linked to educational goals.*

Key tasks for the first stage of ICTE implementation are as follows:

- Determining the areas in which ICT can assist in the realization of education reform objectives: changing curriculum, standards, and recommendations for schools and IVE institutions
- Providing initial access to ICT infrastructure
- Training teachers to meet educational needs that can be supported by the use of ICT
- Creating pilot sites in the regions
- Including ICT-related requirements in conditions of certification for schools’ and for teachers periodically required recertification
- Developing a system of digital learning resources and networked services
- Creating a system of distance education for general and IVE
- Introducing standard operating software followed by e-learning software that is content-related

**Recommendations: Efficient Use of Resources**

Russia has very limited resources for investment in ICT in education. Those resources need to be allocated very carefully. Difficult choices must be made in relation to existing tradeoffs.

**Connectivity and Equipment**

*Orient goals toward providing universal service rather than universal connectivity*

It is impractical for Russia with its vast landmass and difficult terrain to aim for immediate universal connectivity for all its citizens. A more realistic goal is reasonable availability of service (analogous to having a public telephone nearby rather than one in every home) in order to provide access to both equipment and learning materials. This is defined as universal service, and its provision is easier and cheaper than provision of universal access for everybody (or connectivity). In the context of extremely limited resources, an emphasis on the latter can, paradoxically, cause greater inequality of access by leading to the concentration of computers and equipment in selected (successful) schools. (Nevertheless, there is a place for demonstration sites of excellence to showcase significant ICTE-related activities and act as dissemination points for best practice.)
The same limitations apply to having fully operating Internet connections in many schools in the course of the next five years; thus, intermediate solutions are needed. Satellite delivery systems and ICT learning centers with high-speed connections are two possible solutions. The latter has also been suggested in the section above on cross-level cooperation.

Where global connectivity is not feasible, school and community intranets (together with quality educational software provision) seem to offer the most practical means of providing schools with access to digital learning resources. Such networks have low capital costs and minimal running costs with unlimited traffic and high speed. They can connect not only education institutions but also local libraries, and other knowledge bases.

Intranets can be used not only to allow wider access to quality digital learning materials but also for controlled simulated access to a range of Internet resources by copying selected web resources to CD-ROMs.

The provision of ICT facilities outside schools (including home computers) should be encouraged with targeted support and their use studied. The availability of computers and Internet access outside school should be recognised as an important supplementary resource for achieving ICTE goals and should be supported.

On an individual basis, support could be in the form of grants or loans for gifted children from low-income families; on a community basis, the ministry could assist in establishing telecenters to provide access out of school hours to a range of ICT based courses for all.

Direct federal financial support for the use of commercial and noncommercial communication channels and to solving the last mile problem

Building communication infrastructure and Internet service provision are not tasks for the Ministry of Education and regional education administrations. They should use existing channels (including the excess capacity of railroads, banks, and energy channels) or else lobby for their construction. The only channel-related task for education administrations is to develop solutions for the “last mile” problem. In this regard, international experience in satellite-based delivery systems for remote areas could be sought to assist Russia in finding solutions. An example of an affordable model for ICTs in rural areas is Myeke High School, KwaZulu, South Africa (box 2-15 in the Bank report on lifelong learning – World Bank, under development).

Employ economies of scale to reduce unit costs wherever possible

It has already been demonstrated in Russia that under certain conditions, transparent and competitive bidding for large-scale equipment supply can reduce unit costs significantly. Large-scale software supply, coordination of Internet service provision, and centralised development of e-learning materials can all work for the efficient use of limited public resources. Analysis of ministries' present practices of large equipment purchasing is needed in respect of maintenance as well as initial equipment costs. The opportunities for maximum use of resources available have to be established. For example, computers and prepaid Internet access need to be fully utilized (seven days a week) to maximise the return of investment on expensive computer equipment.

Lessons learned from international experience in the selection of learning platforms and development of portals, and from national and local initiatives should be taken into account early and before large-scale learning development initiatives are begun. There are many very expensive traps to avoid.
**Maintenance and supply**

*Treat maintenance and upgrading as a regular expense*

Technology becomes obsolete so quickly that any strategy should predict the problem of upgrading as well as maintenance costs. The cost of supplies such as paper, printer toner, and computer discs also needs to be recognised. Schools and local school authorities face real challenges in financing investment and the recurrent cost of ICT introduction. The recurrent cost of ICT use (maintenance, upgrading, training, supplies, etc) should be eligible for regular budget financing. A preliminary analysis shows that such expenses will be affordable if the education system is able to save about 1 percent of its overall expenses on such things as utilities.

Private sector involvement in providing computer maintenance services for schools should be encouraged and a flexible approach established to find points of common interest for schools and private business. Regional education authorities should play a coordination role.

**Recommendations: Equalizing Access to Better Education by Means of ICT**

This section focuses on support for disadvantaged populations in gaining access to ICT and on the role e-learning materials can play in broadening access to educational services.

**Targeted Support**

*Target disadvantaged populations, including IVE institutions, for special needs-based support and ensure their access to new learning resources*

Many countries have had to face the equity issue when introducing ICT in education. The most adopted solution is targeted, or needs-based, support for disadvantaged groups of students rather than an even-handed approach that can dilute resources right across the system. Given Russia's potential for increasing the digital divide, it is essential that all levels of government monitor the availability of access to ICT not only in schools but also in out-of school settings. Inequality beyond school walls can be an important factor in creating a digital divide.

Students of most IV schools form a disadvantaged group in respect of access to ICT. They have poor levels of access to hardware both at school and at home, even less to the Internet, and they face a dearth of appropriate training software at a time when industry is becoming increasingly computerised.

**The Role of E-Learning Materials in Equalizing Access to Improved Resources**

*Harness the delivery potential of ICT to increase and broaden the availability of learning materials for general and IVE education systems and teacher training*

Given Russia's vast distances and spread of population, e-learning support materials and traditional distance courses could provide many students with access to a full range of educational services currently unavailable to them because of their geographic, economic, cultural, or other special needs.

In particular, widespread adoption of ICT could expand the development of distance courses that are needed to strengthen the quality of provision to remotely located schools and IVE institutions. There are,
for example, distance learning measures that have been used very successfully in Australia, where the terrain is as difficult as it is in Russia, that could be used for the benefit of students in remote locations. ICT could be used as the delivery medium for courses in new subject areas. With the introduction of specialised curricula in the last two years of secondary school aimed at widening student choice and providing diversity in curriculum, many schools will face problems in their supply of specialised subject teachers.

ICT could also be used as an enhancement to print-based courses (supplementary learning resources on CD, tutoring via e-mail etc), or as learning resources to supplement face-to-face teaching. Distance courses could also be harnessed to redress the lack of opportunity that both gifted and disabled rural children face in accessing courses that meet their specific needs.

**Recommendations: Enhancing Teaching and Learning for the Information Age**

This section focuses on the training and support of teachers and the building up of multimedia learning materials and a system of portals to educational networks.

**Teachers**

*Make training of teachers in the use of ICT the Russian government's first priority in its planning to introduce ICT to general and IV education.*

Teachers and education managers and leaders throughout Russia will need retraining to become competent users of ICT and to enable them to make a pedagogical shift to learner-centered approaches. General improvement in teachers’ status, salary, and work conditions is a natural precondition for this shift.

For new teachers, new preservice training standards will be needed to equip them with ICT literacy and the skills to use it effectively as a teaching tool in their subject areas. In-service training should be multiphased, beginning with basic ICT literacy and continuing with cross-curriculum pedagogical approaches and flexible learner-centered approaches utilizing ICT. Training should assist them to avoid simply replicating current classroom practice using a technological delivery system; and to take advantage of the interactive potential of ICT to move to essentially new pedagogical skills. On-going technical support should also be made available for teachers.

Research has shown that the teacher’s own distance from the computer is the main obstacle to effective ICT introduction. Affirmative action will be needed to encourage teachers to purchase their own computers. Experience in some Russian schools shows that noninterest loans for teachers to buy computers can be a powerful way of increasing the number of teachers owning computers. Leasing schemes implemented in some Moscow schools offer interesting models.

**Building Content and Resource Development Capacity**

*Set up an integrated, cross-level system of education portals after in-depth study of international experience*

The design of a system of education portals on the Internet should follow decisions about structure and content of services, and target audiences. The system of education portals has to cater for the specific needs of regions and the degree of telecommunication infrastructure development available.
Design and develop e-learning and distance support materials for use in general and IV schools to be delivered via a range of media appropriate to the end user.

The delivery method and its flow on to the design and development of learning materials must be based on the hard realities of the end users' access, taking into account weak communication infrastructure in parts of the country. Russia's uneven access to telecommunication networks throws up problems that will take many years and enormous capital investment to solve. Until then, on-line, CD-ROM based, and print-based learning materials will all be needed to meet the disparate needs of students throughout Russia.

Courses, where possible, should also be designed to meet the special needs of visually impaired and other physically disabled students. Without this focus on the needs and the circumstances of the end user, inequality of access to quality improvement measures such as expansion of curriculum options will grow rather than decrease; IVE institutions, in particular, are in urgent need of modern high quality e-learning materials.

Build capacity to produce modern multimedia learning materials; for this, train instruction designers and use best practice models.

A fine balance between centralized development of DLM prototypes and course development by teachers has to be found to ensure relevance to the classroom and encouragement of grass roots initiatives.

To date, e-learning materials produced in Russia have largely failed to take full advantage of the potential for interactivity that ICT offers. Despite some obviously talented players in the field, there is relatively little experience in production of quality electronic learning materials of real pedagogical value in the country. Some higher education institutions have been quick off the mark in seeing the earning potential of distance and e-learning materials but have not provided sound models for quality materials development.

Russia urgently needs to strengthen its base of people with both technical and pedagogical know-how about developing learning materials for a range of media. Materials development has either been led by technocrats rather than educationalists – resulting, as a rule, in software of little educational merit – or has been created by enthusiastic teachers with little technical expertise.

A team approach to course development should be adopted, bringing together the skills of content experts (teachers), instructional designers, and technical experts. It is important to build a reliable system of feedback between DLM developer and consumer (user). A prototype of such a system of feedback is being developed within the Education Innovation Project for higher education initiated by the World Bank in 1997.

Russia should take full advantage of its relatively new start to utilise constructivist approaches to building e-learning resources. Constructivism is an approach whereby individual learners construct new knowledge from a variety of resources and experiences. It has gained momentum at the same time as interactive, user-friendly technologies are becoming available, and this is no accident. The approach has important implications for the ways in which learning resources are designed and stored and the way teachers are trained to use them to maximum benefit.

The cost-effectiveness of delivering textbooks in electronic format should not be over estimated. The popular trend to delivering textbooks in electronic format can be a very expensive solution given the current level of technical development in Russia.
The use of digital learning materials (DLM) developed abroad should be considered prior to domestic development in some fields. Russian adaptation of such materials could provide high quality DLM quickly for a comparatively low cost. For example, international experience demonstrates that foreign language learning courses adapt well.

**E-Learning Materials for IVE**

*Through the Ministry of Education, support large-scale development of learning materials suitable for modern methods of IV training and a range of delivery modes, including distance when it can be afforded. Much-needed reforms in Russia’s vocational education are responding to the world trend to competency-based modular training.*

Modular training groups education content around related topics from different subject areas; the purpose is to establish links between subjects so that, for example, a theorem studied in mathematics can be applied in physics. Such an approach demands flexible learning resources that can be addressed independently of the teacher. The approach also needs assessment tools to support courses where all students may no longer be working on the same part of the course at the same time. Such learning materials can promote workplace training and assessment and enable working adults to study outside working hours. Hence the value of the approach for IVE.

The professions and occupations – some of them new – for which curriculum and supporting learning materials are currently being developed will need graduates to be, at a minimum, computer literate and, in some cases, to have computer skills specific to the occupation. It is essential that the use of ICT be embedded in training at this level and that suitable e-learning materials be developed.

Any materials developed for distance delivery should be designed in such a way that elements are also suitable for in-class use. International experience shows some convergence between face-to-face and distance methodologies. A constructivist approach to the design of distance learning materials can provide excellent source material and multimedia resources for the classroom. It can be used to foster student-centered approaches to learning and to assist the classroom teacher in assessment and monitoring.

**The Impact of ICT on School Organization and on Teaching and Learning Practices**

*Introduction of ICT in education will require far reaching institutional changes in the system of education, in general schools, and in IVE institutions*

As the use of ICT accelerates in schools and IV institutes, it will inevitably have an impact on the ways that learning activities are organized and managed at the school level. As the role of the teacher shifts from being a knowledge source to learning facilitator, learning itself will also shift toward greater individualisation of the learning experience for students.

It will affect the minutiae of school life such as timetabling and will even affect how teachers are paid as time in front of the whole class becomes less important and teachers will spend more time on mentoring and tutorials, and developing and locating learning resources for their students.

Use of ICT will also affect assessment methods that will need to be flexible enough to cover unique individualised learning outcomes. Support will be needed for this progressive transformation of school culture and practices within a shift to preparation for life in an information economy.

The role of informatics teachers in implementing ICTE strategy should be reviewed. Today in Russia, informatics teachers are looked to as the natural choice for facilitating the introduction of ICT into
schools. The approach of these teachers is likely to be based on informatics as a subject. Thus, since embedding ICT in educational practices requires shifting away from a pure informatics-as-a-subject approach, they may not be the best choice for leadership in using ICT to support substantive learning and in school management. Those teachers given the task of ICTE leadership should be suitably rewarded.

**Recommendations: ICT Literacy Skills Development**

This section focuses on measures needed to ensure all students are adequately literate in ICT and that students receptive to advanced skills are not neglected.

**Universal ICT Literacy**

*Develop modular courses that ensure students leave school with the ICT literacy skills needed to function in an information economy. Similarly, develop courses to ensure that IVE graduates acquire competence in ICT appropriate for the corresponding new and emerging industries of the information economy.*

Common performance standards for ICT literacy will need to be developed. They should emphasize general information processing skills rather than specific equipment and software use skills.

Computer literacy should be considered as a transferable core skill likely to be required in all occupations. Such training should also be included in retraining courses and courses for adult continuing education. Russia's geographic spread and dispersed population will require creative measures to ensure that ICT literacy can be universal. The ICTE centers described elsewhere will be a central means of providing access but may need to be supplemented by such creative solutions as mobile ICT buses.

**Advanced ICT Skills Training**

Develop modular training courses in advanced ICT skills for students from schools and IVE. Russia must ensure that it develops a cadre of skilled information industry and digital communication professionals. Schools and IV institutions must establish the basis for the training of those wishing to pursue ICT as a profession by providing optional modular courses beyond the basic computer literacy level. These modules should coordinate with secondary vocational education and university courses to allow recognition of learning outcomes already achieved.

**Role of the Federal Ministry**

Taking into account both international experience and that of Russia itself, the following major roles are recommended for the federal government in ICT strategy development and implementation:

*Leadership and promotion of ICT in education.* The Ministry of Education should set out the main principles, guidelines, expected outcomes, and performance indicators for nationwide integration of ICT in education. It should identify and recognize outstanding performance in ICT-related activities in regions, schools, teachers, and the private sector and use its authority and influence to promote discussion on ICT.

*Information role.* The Ministry of Education should develop special indicators and monitor the efficacy of integrating ICT in educational practices. It must keep the professional community and general public informed on ICT related issues and disseminate information on best practice and materials available. Such activity can attract social partners and generate stakeholder support.
Certification role. The ministry must set standards for preservice teacher training in ICT for all trainee teachers and for teachers' certification, including exit exams. The ministry must also set standards for certification of e-learning materials and equipment.

Regulatory role. The ministry needs to build an enabling regulatory framework for effective use of ICT.

R & D. The ministry should support research and development in the field of ICT, especially in the following:

- Development of advanced learning management software tools for schools. These should be designed to generate and present information in forms suitable for all users, first for teaching staff and then for students
- Development of new assessment and evaluation methodology reflecting new learning outcomes including communication competence and ICT skills
- Development of e-learning resources to fill the gap in school supplies left by inadequate market incentives or to create supplies for free public access where that is politically important
- Research on barriers to equal access and means of overcoming them through the use of ICT
- Development of teacher training materials in a variety of delivery modes
- Establishing pilot sites to demonstrate excellent practice in ICTE

Financial role. The ministry should provide direct financial support for priority areas of ICTE development.

In general education, for which the regions have fiscal responsibility, the Ministry of Education can support advanced ICT initiatives or improvement of ICTE programs that fit within the federal strategy with federal funding to be matched by regional financing. The ministry could support both ICT initiatives in demonstration schools and centers in each region and special programs to support the disadvantaged.

- The IVE sector is still federally financed in most regions. Funding priorities should be changed to finance not only hardware, but also curriculum development, teacher training, learning materials development, methodology development, and dissemination.
- The system for financing research and development (R&D) should be made more transparent, publicly accountable, and needs driven.

CONCLUDING STATEMENT

Russia has embarked on the long and arduous task of equipping its citizens to compete effectively as creative members of the global information economy. Its challenges are immense and it will need considerable resources and determined efforts to ensure that the educational benefits flowing from the introduction of new technologies are available equitably across its scattered and digitally divided population.

The Russian government has made a courageous start with the release of its broadly based E-Russia and E-Education policies. It now needs assistance in further development and implementation of its policies. There is much to be done. The following are the priority areas where additional resources can most usefully assist:
- Pedagogically sound e-teaching and learning and distance learning materials for schools and initial vocational education should be developed and made available through a range of delivery media accessible to end users. Concurrently, Russian capacity to develop learning materials of high quality should be built to ensure the supply.
- Pre- and in-service training for teachers should be developed to ensure that ICT is embedded in teaching and learning across the curriculum.
- ICT learning centers should be designed and established to widen access for whole communities currently poorly equipped with hardware. These centers will serve not only the ICT needs of schools and IVE but also foster lifelong learning in the community.
- With a view to increasing access to quality learning materials, a modern cost-effective delivery system of distance education should be developed, using ICT where possible and catering for all levels of education, including adults.
Appendix 1

Krasnoyarsk Region Case Study

[Note: In the absence of ready-to-use complete and complex data for analysis, most information came from different sources and was not comparable. However, much information was collected, and most is up to date for December 2002. The main sources are the following: regional and municipal education departments for statistics; data from a special study conducted as a preliminary to developing a regional program to integrate ICT into education; data from a special sociologic study conducted in preparation for the case-study; interviews with regional education specialists.]

THE REGION IN PERSPECTIVE

Territory

2,339.7 thousand square kilometers. The region covers seven urban and forty-eight rural districts.

Population

3,106,000 people live in Krasnoyarsk region. Population of Krasnoyarsk (Krasnoyarsk region capital city) is about 880,000 people.

Economic Situation

The region receives more money from the federal budget in benefits than it contributes (in taxes, etc.). It has the following well developed key economic sectors:

• Nonferrous metallurgy
• Heavy engineering industry (former military industry)
• Coal industry
• Energy industry
• Timber industry

The small and medium enterprise sector (SME) is relatively weak.

Educational Strategy

The Ministry of Education considers Krasnoyarsk region to be one of most advanced Russian regions in the field of education development. Wide positive experience of innovative schools is accumulated there as well as high education and scientific research capacity.

Recently the regional program of general education development till the year 2006 was approved. Its main strategic goal is to change the quality of general education (GE) in Krasnoyarsk region in the following ways:

• To improve the quality of physics, mathematical, and foreign language education by means of ICT
• To develop students multipurpose intellectual skills
• To develop students’ skills in teamwork and creativity.

Educational Statistics

About 20 percent of the regional budget was spent on education in 2001. Salaries took about 55 percent of the education budget, and about 3 percent was spent for equipment and other durable goods.

General Education Statistics

The concentration of general education institutions in Krasnoyarsk region is 1 per 1,467 km² (the same ratio in Moscow Oblast is 1 per 28.6 km²).

Total regional budget expenditures for GE in the consolidated budget for 2001: R6,215.6 million (US$207.2 million), about 47 percent of which was spent on urban schools.

Total number of schools: 1,521, including 70 percent of rural schools and 30 percent of urban schools.

Total number of students: 377,551, including 30 percent in rural schools and 70 percent in urban schools.

Total number of teachers and administrators: 34,598, including 13,839 in rural schools (40 percent) and 20,759 in urban schools (60 percent); more then 80 percent of teachers are women.

Student/teacher ratio: in rural areas, 8.2; in urban areas, 12.7; average, 10.9.

Average per capita cost of education in 2001: R8,400 rubles (US$280)1; in rural schools, 11,400 rubles (US$380); in urban schools, R7,300 (US$245).

Total number of additional (extracurricular) education institutions providing supplementary educational services for school age students in areas not covered by the compulsory curriculum: 187 (of which 68 percent are situated in urban areas); 184,934 students (46.2 percent of total number of general education students) get education in extracurricular institutions, of which 65 run ICT related courses. Regional expenses for additional education are R22.2 million (US$0.74 million) covering costs for only the four additional education institutions at the regional level.

The remaining 183 institutions are financed from municipal budgets.

Total number of staff in additional education institutions: about 6,000.

Cadet Corps

There is a network of cadet corps in Krasnoyarsk region situated in six cities.

Total number of schools: 8, including 6 cadet corps and 2 girls’ gymnasium.

Total number of students: 2,607, including 2,187 boys of grades 5 to 11 and 420 girls of grades 5 to 11; 8.5 percent of students are orphans; 18.3 percent of students are from families with many children; 39 percent of students are from one-parent families.

Total number of teachers and administrators: 534.

Student/teacher ratio: 4.9.

Average annual per capita cost of education: for cadets, R53,000 ($US1,770); for gymnasium, R21,000 (US$700).

Initial Vocational Education (funded from the federal budget)

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1 Average cost for Russia is about R8,000 (US$270).
Although IVE in Krasnoyarsk region is federally funded, as is customary in Russia, the regional management unit for the system, is unusual in being separate from management of the general education system.

There are three types of IVE institutions in the region: i) school (combining initial vocational and general education programs); ii) lyceum (combining advanced initial and secondary vocational programs); iii) art and craft house (only initial vocational education program).

During 1999, the total number of IVE institutions in Russia decreased by 7 percent, but in Krasnoyarsk region it grew up by 3 percent.

Total number of IVE institutions by 2001: 88.
Total number of teachers and administrators: 1,124; 32,900 students are getting an education in 160 occupations.
Proportion of IVE graduates obtaining employment: 93 percent (average for Russia overall is 76 percent).
Average per capita cost of IVE education in 2001: R12,000 (US$400).² A significant proportion of these costs is met from the revenues of IVE institutions themselves, although the amount is hard to estimate as it varies from one school to another, and they do not make those sums known.

Secondary Vocational Education (funded from the federal budget and by branch ministries responsible for specialized fields of training)

There are two types of SVE institutions in the region: i) college (combining advanced secondary vocational and general education programs); ii) technical school (combining secondary vocational and general education programs).

Total number of SVE institutions by 2001: 65.
Total number of students: 56,182.
Total number of teachers and administrators: 3,545.
The average per capita cost of education in 2001: about R13,000 (US$430).

Higher Education (funded from the federal budget and private sources)

The region takes third place in Russia by quantity of higher education institutions.
Total number of HEIs: 37, including 19 state and 18 private.
Total number of students: 98,200, including 94,400 in state HEIs and 3,800 in nonstate HEIs.
Total number of teaching staff and administrators: 5,106.

General Conclusions

There is a high concentration of education institutions in big cities. Concentration in rural areas is low. Most general and initial vocational schools situated in remote and rural areas are small. Most privileged general schools (lyceums and gymnasia) are situated in big cities in wealthy districts.

There is a strong potential for human development in the Krasnoyarsk region, both to preserve traditions of quality and to develop further. Existing industry requires highly skilled workers and technicians, and the small and medium enterprise (SME) sector requires a vast set of skills that are not produced in

² Average for Russia is R5,975 (US$200).
sufficient quantity. The labor market is not yet sending a sufficiently clear message to the education sector, but obviously both existing and emerging sectors of the economy require a workforce that is competent in ICT.

ICT STATUS OF THE REGION

Telecommunication Infrastructure

Most of the region is covered by telecommunication channels – telephone lines, fiberoptic, copper, radio, digital channels, satellites – owned by both the private and government sectors. Telephone density in the region as a whole was 18.2 lines per 100 of population in 1999, compared with an average for Russia of 21.9.

Regional Telecommunication Networks (Channels)
The main telecommunication operators are the following:

- **Rostelecom** ([http://www.rostelecom.ru/](http://www.rostelecom.ru/)) uses its own national telecommunication network: analog, digital, and radio channels, which cover most of the territory of Russia. They are used for local, interstate, and international telephony as well as for electronic data exchange. Rostelecom has no wide network in Krasnoyarsk and operates as a wholesaler of Internet traffic. It is controled by the Ministry of Communication.

- **Sib-TransTelecom** (a branch of “TransTelecom” serving the territory of Krasnoyarsk region) is controled by the Ministry of Railways (51 percent of bonds belong to seventeen regional railway departments). It owns a high-speed telecommunication network (100 percent fiberoptic lines) alongside the extensive Russian railway infrastructure, and develops it for commercial purposes. The network covers seventy Russian regions with about 90 percent of the country’s population (see figure A1.1). In Krasnoyarsk region it connects main cities in the middle part of the territory by high-speed (2.5 gigabits per second (Gbps) fiberoptic lines. It has no network inside Krasnoyarsk city.

- **Krasnet** regional telecommunication network is a branch of the biggest Russian telephone communication operator, Electrosvyaz. Krasnet has 65 percent of the telephone communications market in Krasnoyarsk city and about 100 percent in the rest of the region (see picture A1.2). Krasnet owns digital channels that connect with Rostelecom’s and Sib-TransTelecom’s communications hubs. It uses its own digital and analog lines to connect with the northern territories.
• *Sibchallenge-Telecom* (www.sibchallenge.ru) is a regional partner of the “Russia-on-line” company (Russiawide Internet provider) and has a wide telecommunication network within Krasnoyarsk city.

• *Svyaztransneft* uses its own telecommunication network. It is controlled by the Ministry of Oil Industry and connects oil industry organizations. It is partly used for other commercial purposes.

• Krasnoyarsk engineering bureau, *Iskra*, is a joint-stock company controled by the Russian government (http://www.kras.ru/). It has developed the satellite network *Angara* in the region providing the only reliable and cost effective access to remote northern territories for those who can afford it.

• Communications hub *NorCom* was created and is supported by Norilsk Nickel Plant; it owns two satellite channels providing dial-up Internet access in four main northern cities.

• *Sibintec* was founded by the YUKOS Oil Company. It is implementing a 1.5-year, US$13.5-million project aimed at providing telephone connection (that is Internet access) in all cities and villages of the northern territory, Evenkia.

Telecommunication networks inside cities are poorly developed that causes last-mile problems. A study of connectivity on the level of education institutions shows that there is a so-called last-mile problem in connecting individual IVE and GE schools with the main channels of communication. Almost all connection that exists is done by poor quality dial-up access, because the cost of good quality last-mile links is too high – about R99,000 (US$3,300) per kilometer of fiberoptic line. Nevertheless, most state HEIs have good quality fiberoptic connection.

Good quality digital telecommunication channels with high throughput capacity connect all main big and small cities in the region. Different industrial structures (mainly governmental) own or control these channels and use them for commercial purposes (by leasing to third-party firms) as well as for sectors’
needs. There is a good opportunity for price competition as the capacity of different networks is similar and market potential is high.

The picture is different in the north. Four analog lines, one digital line, and some satellite channels connect some northern territories (five towns) with the central part of the region. But small northern towns and villages have only poor dial-up access. They are connected by poor quality analog lines that are not good enough either for reliable local or for long distance telephone connection. In some northern areas, the population is so small that it is unprofitable to construct any channels of communication. Terms of payback are so extended – about sixty years – that owners are not interested in constructing new lines.

This paragraph lists national level educational nonprofit networks active in the Krasnoyarsk region and aimed at HEIs. They are not used by general and IVE schools. Russian Backbone Network (RBNet) rents digital channels and gives Internet access to Krasnoyarsk State University (KSU) Internet center and the KSU local network. Russian University Network (RUNNet) has a backend node in Krasnoyarsk city. RELARN, the regional branch of the association of scientific and educational organizations, is a network of users of computer networks serving Krasnoyarsk State Technological Academy.

**Conclusions Regarding Regional Telecommunication Networks**

Quality of communications vehicles linking the northern, central, and southern areas of the region ranges from excellent to abysmal.

The last-mile problem is still to be solved for the general and IV education sector.

The key conclusion is that existing telecommunication infrastructure cannot solve the problem of connecting general and initial vocational education institutions to local, regional, or global computer networks. In remote and rural areas, this is because of a general lack of communication infrastructure; in cities it is because of the last-mile problem. Investment in the last mile is required.

**Main Internet Service Providers (ISPs)**

This section will describe the costs and quality of connection in territories where the opportunity to access the Internet exists.

There are about twenty Internet service providers (ISPs) in Krasnoyarsk city. The main providers and costs of services are shown in table A1.1.

<table>
<thead>
<tr>
<th>ISP</th>
<th>Setting up dedicated channel, 256 Kbps ($)</th>
<th>Traffic cost ($ per month)</th>
<th>Gb included in monthly traffic</th>
<th>Dial-up access for 50 hours ($ per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iskra</td>
<td>144</td>
<td>408</td>
<td>4.0</td>
<td>0.60</td>
</tr>
<tr>
<td>Krasnet</td>
<td>120</td>
<td>330</td>
<td>3.9</td>
<td>1.20</td>
</tr>
<tr>
<td>Krastelecom</td>
<td>70</td>
<td>384</td>
<td>4.0</td>
<td>0.55</td>
</tr>
<tr>
<td>Krastelecom Service</td>
<td>100</td>
<td>273</td>
<td>4.1</td>
<td>0.80</td>
</tr>
<tr>
<td>Rostelecom</td>
<td>180</td>
<td>258</td>
<td>4.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Svyaztransneft</td>
<td>70</td>
<td>288</td>
<td>4.1</td>
<td>0.50</td>
</tr>
<tr>
<td>Sibchallenge</td>
<td>190</td>
<td>272</td>
<td>4.0</td>
<td>0.40</td>
</tr>
</tbody>
</table>

*Note: All costs include taxes. Column 2 shows the lump sum for getting access to a digital channel with a speed of 256 Kbps. As soon as a digital channel is available, the organization makes a contract with the ISP that limits the volume of incoming information in gigabits (Gb), which we assume to be close to 4 Gb (column 4). If the...*
organization’s incoming traffic exceeds 4 Gb, the excess is charged at a special rate (usually $0.05-0.10 per Mb). Monthly payments for Internet access (256 Kbps, 4 Gb) are presented in column 3. Column 5 indicates the cost per hour of dial-up Internet access with a speed of about 28 Kbps for 50 hours. Krastelecom and Krastelecom Service were previously one company, now separated into two. 

Source: Data taken from ISP price lists.

Representatives of ISPs say that today it is rare for them to give special discounts for their services to education institutions. This is because schools are not seen as potentially good clients with a high capacity for using the Internet. The ISPs see the situation as changing as soon as local interschool networks are established and several schools can act as one single consumer with strong demand for Internet resources. However there are opportunities for schools – though they are somewhat limited – for low-cost, or even free, access to the Internet. An ISP (Sibchallenge-Telecom) provides free-of-charge Internet access for fifteen schools in two cities. Krastelecom Service and Krasnet companies also support introduction of Internet to schools. Unfortunately such initiatives do not always get appropriate support from authorities.

There are technical possibilities for linking schools with Internet providers especially in big cities and towns along railways. Existing market conditions could stimulate the reduction of ISP costs in big cities. However, the communications channels for small remote towns and villages are very weak, and there are no incentives to construct/modernize channels there.

The slow speed of dial-up access limits the value of schools’ connection to the Internet. The cost of connection through the faster dedicated/digital channels is relatively high; however, with external support for better funding, schools could gain the benefits of such higher capacity by collaborating to create local computer networks. General schools and IVE institutions joined in this way would create the necessary economy of scale to lower comparative traffic cost.

**Network Access to Digital Information Resources in Education**

Digital networking provides students and teachers with two important resources: 1) access to digital information and educational resources; and 2) opportunities for communication with the extended educational community.

1. Access to digital information resources means that education information should appear at the computer in front of a student. A source of information can be:

   - Own institutional local network
   - A network of a cluster of different organizations on the city or regional level
   - Internet

2. Communication between members of the educational community can also be increased on these three levels. The role of ICT in enhancing educational communication (as a part of networking) is underestimated at the moment.

We will study the current state of development in the three options that were listed above for level of connectivity in Krasnoyarsk region. The key issues to be solved are: users’ demands for resources and communication, content of existing networks, data exchange speed, and cost.
**Institutional Level**

*Digital information resources.* About 11 percent of general schools and 14 percent of IV schools have local networks. Traffic cost within these networks is *zero* and the speed is very *high*. However the resources (education content) concentrated within these networks are very poor. Moreover, according to interviews, some institutions put only small amounts of management related information there. The problem: even if a school were to try to put more resources into a network, it would face some limitations from hardware, as the capacity of servers in these networks is usually quite limited.

*Communication between educators.* Only a few schools use local networks for communication and to establish circulation of electronic documents.

**Clusters Level**

Regional clusters of networking institutions, set up to exchange information and resources are known as Intranets. Educational institutions have two options for building local networks to solve issues of infrastructure and traffic cost.

*Constructing physical channels of communications for themselves.* “Education – Library Network” (described in Box A1.1) has been established with the idea of according educational institutions the opportunity to construct their own physical channels of communication. The cost of constructing such networks is rather high, as each kilometer of fiberoptic line costs about R99,000 (US$3,300).

**Box A1.1 Education – Library Network**

*Since 1999, Education – Library Network in the city of Krasnoyarsk has been developed with the idea of according autonomy in digital networking to educational institutions. It will connect most HEIs, the state library, three district interschool ICT centers, and a number of scientific institutions. It provides high-speed information exchange and free internal (local) traffic. A noncommercial ISP (RBNet) provides access to the Internet on preferential terms so incoming Internet traffic is not expensive. Education content includes i) administrative information (mainly reference books), ii) institutional web sites, iii) digital texts, etc. The network construction is financed from the federal budget.*

Using the existing channels as well as new ones to link education institutions with regional servers. There is already good telecommunication infrastructure in some parts of the region and the capacity of its channels is high. However, the problem of the last mile still has to be solved, and some agreements remain to be completed with the owners of commercial networks. The regional educational computer network “CROSS” (see Box A1.2) is moving in this direction.

**Box A1.2 “CROSS” Computer Network**

*The regional educational “CROSS” computer network (www.cross-edu.ru) was established in 1993 and financed from the regional budget. The network connects regional education institutions that have access to e-mail with offices of general administration in the cities and in most districts. Forty-three urban and twenty rural schools currently have access to it. “CROSS” is based on a mail server and uses the channels of the commercial network Krasnet to exchange information in off-line e-mail mode. Krasnet provides toll (intercity) telephone lines free of charge to connect the mail server. Education content is normative and regulatory documentation in the field of education, news line, a limited number of regional education publications and learning materials, and e-mail service.*

Today in the region, education administrations and HEIs are putting a lot of effort into developing local interinstitution education networks. There is a clear trend toward developing local computer networks as a means of getting access to digital information resources.
This effort has not yet reached the secondary school level although a very few local off-line school networks do have unlimited traffic within Krasnoyarsk city and limited traffic outside the city. For all practical purposes, general and IVE school students have, as yet, no regular access to local education networks.

**Internet Access**

About 4 percent of regional general schools in Krasnoyarsk have access to the Internet by dial-up mode with a speed of about 32 Kbps. (For Russia as a whole, the average percentage of general schools having Internet access is between 1 percent and 2 percent.) However, the real opportunity for students to use Internet resources in schools is very small because of the speed limits on information exchange; only two schools have dedicated channels. Nevertheless, 96 percent of urban and 98 percent of rural schools have at least one telephone line through which they could get access to the Internet or to off-line emailing. The research data show, however, that most teachers and students in such schools, which could have access to Internet or could be connected for email through an ISP, have no idea that this is so.

Within the framework of the municipal program for integrating technology into the education system for Krasnoyarsk city (for the period 1998–2000), twelve advanced schools (less than 10 percent of all city schools) and seven ICT resource centers got dial-up access to the Internet. Now, in Krasnoyarsk city, almost 20 percent of schools have Internet access. The average Krasnoyarsk city school that is connected to the Internet uses the worldwide web about 40 hours per month.

Analysis of the places where general school students in Krasnoyarsk city are getting Internet access shows that the two most popular places are i) friends’ houses and parents’ places of work (22 percent of students) and ii) Internet cafés, where 12 percent of students get Internet access. Only 6 percent of all students use home computers as the main place to access Internet, but they are also the only students that use the Internet every day. Less than 5 percent of students get connected in schools and in centers of additional education. This number is very small especially considering the fact that, as noted above, almost 20 percent of Krasnoyarsk city general schools have Internet access.

Data from regional education administration confirm that less than 10 percent of Krasnoyarsk region IVE schools have Internet access in dial-up mode.

About 10 percent of 9th grade students, 21 percent of 11th grade general school students, and 7 percent of IVE institution students regularly visit educational Internet sites. However, neither rural students, nor rural and urban teachers of general and IVE schools use such sites at all.

Most HEIs (about 92 percent) are connected to the Internet: 54 percent by dedicated copper cables, 15 percent by fiber optic dedicated cables, and 23 percent by dial-up. HEI students can get free access to Internet or can be charged R10.0 to R15.0 (US$0.3-0.5) per hour.

**Box A1.3 KSU Internet Center**

The Internet center in KSU (established by a Soros Foundation grant) provides Internet access for students and professors as well as for the public. There are five computer classes, one library class, and sixty-five workstations. The Internet center has about 10,000 clients of whom 50 percent are students and professors of KSU. The Internet center has a wide bandwidth fiber optic channel. It also operates as an ISP. The speed of connection on an individual computer in the center is very slow (there are about 200 computers connected to Internet in the university) and often does not exceed 1.0 Kbps; the channel is obviously overloaded, and Internet class capacity is not enough to meet the demand of a public even as restricted as a university community. A KSU student can get not more than eight hours a week of Internet access. Student Internet access in other Krasnoyarsk HEIs is no better.
The example given in the box above shows that the existence of access to Internet in an educational institution does not mean that students have access to Internet. There are no data showing how many computers used by students have Internet access and what their speed of access is.

As noted above, schools do not fully use the opportunity that is provided by e-mail as a mean of communication. This can be done in off-line mode through dial-up access to an ISP, and the cost is quite affordable – about R90 to R150 (US$3–5) per month. Only 5–10 percent of schools use e-mail on a regular base. It shows that schools do not demonstrate a real demand for active professional (pedagogic) communication. Education authorities do not encourage schools to use e-mail, although 100 percent of education authorities in the region have e-mail accounts.

**Issues Common to the Three Options for Connectivity in the Region**

To get access to an external computer network – local regional or worldwide – a school has to have at least four resources, as follows: i) proper hardware (computer, server, modem); ii) telephone line or other channel of connection (dedicated copper, fiberoptic, radio line); iii) money to pay for the traffic; and iv) intention to use (or demand for) digital information resources.

Today all the four requirements for getting connected bring out certain difficulties. If a school wishes to use remote digital information resources it has to consider and solve three problems; they correspond to the first three of the four needed resources listed above:

- **First**, computers and/or servers have to be more or less up-to-date to be able to run the appropriate software and to support proper modems. At the moment far too many schools are equipped with old fashioned computers, sometimes of the 1980s generation. (About 50 percent of computer classes need to be updated.) See section on “Hardware” below for details.

- **Second**, dial-up Internet access is the only means of connection most schools can afford. Although about 99 percent of regional general and IVE schools have a telephone line, too many have only one (more than 20 percent of urban schools and 99 percent of rural schools), and this, moreover, is quite often old and does not satisfy even minimum requirements for reliable data exchange. Even were the line reliable enough, however, Internet use blocks phone communication, while it is in progress, an obvious drawback.

- **Third**, the Internet traffic is too expensive for all schools to use the worldwide web regularly. The average cost for Internet access by local providers is from R12 to R36 (US$0.4 to US$1.2) per hour during daytime with speed less then 32 Kb/sec. Not more than two or three computers could work on the Internet at the same time. Gymnasium #1 pays R1,800 (US$60) per month for 38 Kbps unlimited dial-up Internet access, and this is special price; normal would be about R4,500 (US$150) per month. For rural schools the situation is even tougher. They don’t have many options in choosing a provider and the price they have to pay is 10–15 percent higher. Access by dedicated channel costs about R9,000 (US$300) for 40 Gb per month. Considering that during last year, schools were suffering from lack of money for basic supplies (textbooks, simple furniture, etc.) these options look expensive. Telecommunication expenses are not eligible for budget financing. Almost 100 percent of schools in Krasnoyarsk pay for Internet from nonbudget

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3 We do not consider other channels as a realistic common solution because the capital and running cost is unaffordable for schools at the moment.
incomes – that is, sources of financing outside municipal or regional or federal budgets for education. Quite often, telecommunication expenses are financed by parents’ money.

**Box A1.4 Regional Ideas**

| Some computer/resource centers (for example, Children’s Additional Education Centers) are considering the option of connecting to the Internet via a dedicated channel. They see it as feasible if they can attract additional financial resources as fees for chargeable educational activities, including Internet related courses. The centers’ specialists also suggest creating a special education fund to accumulate money from budgetary, private business, and other sources to pay for the traffic of all regional education institutions that use the Internet. |

All the means of connection used in the region have some advantages and disadvantages but simple lack of money gives schools no other option but dial-up.

The total nonrecurring costs of providing every school in Krasnoyarsk city with Internet access is about R7,890,000 (US$263,000): forty-three general schools with more than 1,000 students would get a dedicated line connection costing about R90,000 (US$3,000) per school and 103 schools with fewer than 1,000 students would get dial-up connection for about R39,000 (US$1,300) per school. That is less than 1 percent of the Krasnoyarsk city budget for education. The same calculation can be used for IVE and it would result in an outlay of R858,000 (US$28,600) for 22 IVE schools.

Running costs would be on top. Under current conditions in the Internet service market, total monthly running costs for providing Internet access to every school in the city would be R850,500 (US$28,350) without discounts: R4,500 (US$150) a month for unlimited dial-up access and R9,000 (US$300) a month for access via dedicated channel with 4 Gb of incoming traffic. Total running cost of providing Internet access for all IVE schools in the city can be evaluated (according to the same scheme) as R99,000 (US$3,300) per month.

- **The fourth** needed resource – intention of teachers to use ICT in schools - is in short supply because the schools’ teachers and administrators do not see themselves as a part of a wide education community. Low e-mail use demonstrates that they do not experience a need to communicate actively with their colleagues in order to solve similar problems. Furthermore, there is a great lack of instructional support for using Internet in the education process. Interviews with school teachers and administrators show that most education specialists do not know about most education resources available on the Internet. They are not expected (there are no official requirements) to use them in teaching practice, and in actuality they are unable to do so, having had no special training in the use of the Internet.

**Conclusions Regarding Access to the Networks and Digital Educational Resources**

The main obstacles to running active computer networks (including Internet) use are the following: i) equipment is out of date, ii) telecommunication infrastructure and access quality at the institutional level are poor (the last-mile problem), iii) traffic is expensive, and iv) the need is not realized fully. Overcoming the first three obstacles, first of all, requires funding; the fourth requires institutional changes.

The regional education administration gives support to the development of regional education computer networks, but it is focused on higher education. However, the problem of the last mile is not solved for general and IVE schools. High-speed access to telecommunication infrastructure in order to use Internet resources is too expensive for a school, and the quality of dial-up connection is very poor.
The priority for schools is not to have regional education networks or Internet as such. They need access to digital resources. Those resources can be (and they actually are now) spread all over the Russian Federation and are available via the Internet. They can be (and some of them are now) accumulated in regional or even local institutional education networks. Schools’ work in Intranets (local cluster networks) will teach them how to use Internet and will create real demand for future Internet use. So there is a tradeoff between Internet and Intranet.

A short-term solution for networking an educational community may be extensive use of Intranet. The advantages of local networks are as follows:

- High speed of data exchange (up to 2 Mbps) versus slow Internet (less than 56 Kbps)
- Cheap traffic (close to $0) versus expensive Internet
- Opportunity to control and manage content of network
- Easy information search process with clear and relevant search results
- Strengthening of educational, scientific, and cultural cooperation in the region
- Extended opportunity for development of distance education
- Low operation costs spread among different servers’ owners

The local networks’ disadvantage is that they are closed systems. However, that is easy to overcome through regular content up-date service determined by users’ requirements.

Looking ahead to the future: as noted above, the total cost of providing every Krasnoyarsk city school with Internet access is less than 1 percent of the Krasnoyarsk city budget expenditures for education. That means that the price for a breakthrough in providing Internet access is quite affordable for the municipal budget.

The need to implement ICT in education is not realized fully at the school level. However, the regional institutions of teacher training and private (financed by YUKOS Oil Company) Federation of Internet Education center provides, fully free of charge, training in several areas of ICT for school teachers and administrators. The result is to give school staff wide opportunities for, and a perspective on introducing ICT (and Internet) to education process.

For now, however, students scarcely use school computer classes to access the Internet. This situation also demonstrates that the ‘number of schools connected to Internet’ indicator does not reflect the real situation with students’ access to Internet and can hardly be used to measure the success of ICT in education programs.

Students from rural areas are at a great disadvantage in terms of access to the networks and digital educational resources.

**Hardware**

An interview with representatives of the Krasnoyarsk city education administration reveals that from 1985 to 1997, there was no centralized computer supply at all to schools in the region or in Krasnoyarsk city.

**Equipment**
The disparity between urban and rural schools in student to computer ratios has been modified significantly by the equipment made available through President Putin’s *Computers for Rural Schools* program.

*Krasnoyarsk Region.* Today, the total number of computers in schools of the region is more than 8,000; of these, 5,775 (72 percent) are situated in urban schools and 2,240 (28 percent) are situated in rural schools. The situation with rural school computerization changed significantly in 2001 when 1,640 computers were supplied under the presidential *Computers for Rural Schools* program. The effect was to decrease the student-per-computer ratio in rural schools from 193 in 2000 to 51 in 2001 – way below the ratio in urban schools in 2001 (188 students per computer). In 2002 the *Computers for Urban Schools* program supplied 4,265 computers to the regional urban schools and the ratio improved to 46. The average student-per-computer ratio across the region in 2002 was about 47 (113 is the average for Russia.). By the end of 2002, the share of general schools in the region with at least one computer was close to 99 percent. At the same time most of small primary schools did not have any computers and most of rural schools had from one to three computers.

However the big part of rural schools’ hardware resources still consists of outdated equipment (computers, servers, printers, scanners). Officially, hygiene and sanitary regulations forbid the use of old computers for education. Nevertheless, most schools (especially in rural areas) are still using first generation computers supplied between 1985 and 1992.

**Box A1.5 Aging of School Computers**

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The principal of rural school #4 in Berezovka noted that they have some “good” computers and some that are “a bit old.” She mentioned that “twelve of them are 486 SX.” When asked how many good computers they have, she replied, “twelve 486 SX are good and ten Yamahas are a bit old!”
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Rural school administrators consider the absence of modern equipment as the last of the total of eleven obstacles to integrating ICT into schools that had been raised with them in a multiple choice questionnaire. Among urban school administrators, that obstacle has second priority. At the same time, survey data shows overload of the computer class as obstacle number one for urban schools and number ten for rural schools.

Beside being installed in computer classrooms, computers can be found in accounts departments and administration offices, but school libraries and methodological offices are rarely computerized.

*Krasnoyarsk city.* Total number of students is 115,000. The total number of schools in the city is 146, of which almost 95 percent are equipped with computer classes. Before 2002 the city education department has the target of providing each school in the city with an average of 14 computers in order to meet base curriculum requirements for *informatics*. Today, the total number of up-to-date computers (Pentium, Celeron, etc.) in schools of the city is more than 2,100. The average ratio of students per computer is about 53. In some schools this ratio is 20-30.

The average number of up-to-date computers per Krasnoyarsk city lyceum or gymnasium is 26 and the schools have 1.8 computer classrooms on average; the same ratios for the average normal school are 15 and 1.4. The ratio of students per computer is 32 in privileged schools and 54 in normal schools.

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4 Official education administration statistics.

5 An average of fourteen computers per school will provide a ratio of not more than three students per single computer during a lesson in a computer classroom.
Interviews with general school teachers and administration revealed that at least 2 computer classrooms are needed in every school. Such improvement will allow to make use of ICT not only at informatics classes but at other lessons as well. The interviewed teachers also mentioned that each school needs at least 3-5 additional computers to be installed in subject classrooms and the staff room.

Krasnoyarsk city education administration department estimates the cost of installing one computer class (10+1 computers) as R300,000 (US$10,000).

According to data from Krasnoyarsk State University and Regional ICT Center all IVE institutions are poorly equipped with computers and student-per-computer ratio is about 90. Since IVE schools serve only students of high school age, it is not really correct to compare them to general schools. Nevertheless, the fact is that children studying in high school have better access to ICT of comparable quality than children of the same age studying in IVE schools.

**Conclusions Regarding Access to and Use of Equipment**

The significant progress in providing computer equipment for general schools was made during 2001-2002. Computer supply within the federal program *Computers for Rural Schools* improved the imbalance between urban and rural school computerization. However, computer classes in urban schools are still overloaded, while the intensity with which computer classes are used in rural schools is much lower. This may be because staff training in ICT is lower in rural schools and the number of students is smaller. Moreover, rural schools are less accustomed to modern computer classes, and time is needed for it to become the usual practice to use them for educational purposes.

Regional IVE schools are poorly equipped with computer hardware especially comparing to general schools. There is also a big gap between the privileged gymnasium and lyceums and the normal schools in the availability of computer equipment (and ICT access).

Research data indicate that the gaps in ICT skills caused by schools’ modest means are compensated for by students having access to computers in other places – their own homes or those of friends, school resource centers, parents workplace, and so forth. This opportunity is much greater in urban areas compared to rural districts. However, as noted above, educational administrators and school teachers do not consider computers at the homes of students and teachers as an important resource.

**Running Cost**

All running costs are generated by one or other of two categories: 1) supplies, 2) maintenance service.

The costs of supplies (paper, printer cartridges, floppy disks, etc.) are not eligible for funding from municipal or regional budgets. Schools, therefore, usually finance yearly supplies in advance, from non-budget sources: per computer class, the usual quantities are as follows: 2 to 3 printer cartridges, about 20 mouse pads, 3 to 5 mouse units, and 3 to 4 packs of paper for office needs, for a total outlay of about R10,000 (US$330). Students buy all the floppy disks and paper they need in computer class. Most schools save money on supplies and neither students nor teachers can use printers as much as they need for education purpose. Thus, according to interviews, for lack of paper, schools do not use printers actively (for example, students cannot print out their essays, projects, or texts for home reading, etc.).

Computer maintenance service (when the warranty expires) is estimated by a regional specialist to cost about 5 percent per year of the fixed cost of equipment. Krasnoyarsk municipal education department considers that cost as quite affordable for the municipal budget, and the expenses for computer
maintenance are eligible for financing from municipal and regional programs for integrating ICT into education. Nevertheless, the funds allocated are not enough to satisfy the demand, and there is no special service for schools. All schools themselves, therefore, look among computer firms for maintenance services. The cost of these services is hard to estimate at the school level as it depends on variety of factors such as age of computers, the intensity of the activity of using them in computer class, degree of breakage, and so forth.

Krasnoyarsk Children’s Additional Education Center has supplied us with an estimate of the costs of overall technical assistance for ICT in regional schools. These costs include work of specialists on maintenance, supplies (unlimited use or use as much as one needs), and spare parts for equipment. The average amount of these expenses is about R40,000 (US$1,300) per year per computer class (10 Pentium workstations).

All the schools noted maintenance service as a problem. In the year 2001, the warranty service for computer supply during 1998–2000 (municipal program for integrating ICT) expired, and funds allocated since then for maintenance from budgets have not covered the real demand.

Schools have three possible ways to handle problems of that sort. The first is to find money somehow and pay a firm (usually a low price for poor quality service). Some schools get discounts from firms where their graduates are occupied or may even attract them free of charge. The second is to have school “specialists” (informatics teachers, etc.) fix breakages. The third solution is to ask the local community for help, and sometimes this solution is very efficient. Even in rural areas there are some self-taught (without any specialized education) people – “Levsha” – who can fix almost any computer related problem and are happy to help local schools for free. But these local and impromptu solutions are completely inadequate for the system in whole.

**Conclusions Regarding Running Costs**

The reality is that an economically efficient way to solve the maintenance problem is still to be found. One possibility is through a unit within the ICT department of a higher education institution; this would give advanced students an opportunity to pass exams through the practical exercise of their skill while providing computer maintenance service to schools. However, all options so far proposed only relieve schools of the costs of labor. Such options do not solve the problem of financing components and cannot be considered a complete solution. That could be provided by a comprehensive computer maintenance services established under the control or supervision of education departments at regional or municipal levels.

The private sector should also be motivated and actively involved in solving the maintenance and supplies problem. A flexible individual approach should be implemented in this area, giving each school a blueprint (guidance) for finding the most efficient way of financing those expenses. Supplies are as important a part of ICT use as computers themselves, and their lack will be an obstacle to the effective use of ICT in education. There must be funding for supplies on a regional/municipal level. Their costs are quite reasonable.

**Upgrading**

Until the year 2001, there was no centralized budget financing for upgrading old computers. Now the 2001–2004 regional program for integrating ICT allows some funding for the upgrade of 120 of the existing computer classes. For this purpose, R787,600 (US$26,000) was reserved in the regional budget for upgrade and maintenance in the year 2001; that is 0.013 percent of the total regional education budget.
The Krasnoyarsk 1998–2000 municipal program for integrating ICT into education financed computer supply in 1998, and in 2000, it financed upgrade of these computers. There was no money to finance upgrade of computers bought in 1999 and later. Cost of computer upgrade after two years of use is about 20 percent of the original equipment cost. Thus, once every two years, schools, need to spend about R30,000–R35,000 rubles (US$1,000–$1,200) to upgrade fully eleven workstations in each computer class, as estimated by a regional specialist. All the schools noted computer upgrade as a problem.

Conclusions Regarding Upgrade

The upgrade process in the region is not systematic. Neither regional nor municipal budgets provide appropriate financial support, and every school solves the issue in its own way, depending on its nonbudget income. However, upgrading can easily be planned in advance (unlike maintenance, for instance). Transparent standards for financing upgrades should be established at the regional level, and appropriate financial support should be provided in order to keep existing hardware capacity in a condition to be used effectively.

Sources of Funding for ICT in Education

The introduction of ICT into education in both general schools and IVE institutions can be funded from six possible sources:

- Federal budget
- Regional budget
- Municipal budget
- Donors’ funds
- Schools’ nonbudget incomes
- Public sector support (trustees, private business)

Federal budget. Computers for Rural Schools, the presidential program for education, and Computers for Urban Schools gave 5,900 computers to rural schools in the region. It was 50 percent financed from regional budget.

Regional budget. This is the source for implementing the regional program for 2001–2004 to introduce ICT to education. The total cost is almost R135 million (US$4,500,000). The regional budget is also the source for cofinancing municipal programs introducing ICT, of which the total cost is about R42 million (US$1,400,000).6,7

Krasnoyarsk municipal budget. There are 146 general schools in Krasnoyarsk. Actual municipal budget expenses for general and preschool education were R1,222.2 million (US$40.74 million) for 2001. The total cost of Krasnoyarsk municipal E-education program for 1998–2000 was about R21 million (US$700,000). It included 88 percent from the municipal budget, 5.2 percent from the regional budget, and 6.8 percent from nonbudget sources. During 1998–1999, thirty computer classes were installed; about

6 See the section “ICT programs in education” for details of the program to introduce ICT.

7 By the time this case-study was completed, implementation of the regional program for introducing ICT had been frozen by the regional legislature, as most of the budget money was spent to raise teachers’ salaries.
R15.9 million (US$530,000) was spent for hardware (76 percent of total expenses) and R2.22 million (US$74,000) for maintenance and upgrade (10 percent of total expenses).

During the year 2001 (within the framework of the municipal E-education program for 2001–2003), about R10.05 million (US$335,000) was spent for hardware (almost 65 percent of the 1998–2000 amount) and US$0 for software.

A one-time outlay on modern computers to meet the current demand in Krasnoyarsk city schools would work out as follows. Today, there are about 2,100 computers in Krasnoyarsk schools or 1.4 computer classrooms per school. While the actual need is at least 2 computer classroom per school (one for teaching informatics and the other for teaching other subjects), and 4 extra computers per school for subject classrooms. Thus, about 1,500 additional computers needed to strengthen the existing capacity. The estimation of the need for related financial resources is the following: 1,500 computers x R30,000 (US$1,000) per computer equals R45 million (US$1.5 million). Cost of an educational software package is 30 percent of hardware cost and totals R13.5 million (US$450,000) for the new computers. So the total need is about R58.5 million (US$1.95 million) This is 4.8 percent of the municipal budget expenses for education in 2001 and exceeds by 39 percent the 2001–2003 budget for the municipal E-education program, which provides about R42 million (US$1.4 million).

Over and above these sums are the related expenses. Total demand for ICT related expenses for Krasnoyarsk city is estimated further, below.

The initial investments for building technical capacity to provide reasonable access to ICT:
1. Computer classes (hardware and software): R58.5 million (US$1,950,000)
2. Internet access: R7.89 million (US$263,000)
3. Teacher training: 290 teachers (approximately two from each school) x R3,450 (US$115) per teacher (10 day course of training school teachers in ICT, the course covers nine topics, fifty teachers are joined in one group for training) equals R1,000,500 (US$33,350).

Total demand is R67.4 million (US$2.25 million). This equals 5.5 percent of municipal budget expenses for education in 2001 and 160 percent of the budget for the municipal E-education program for 2001–2003.

Running costs per year:
1. The expenses for supplies: R10,500 (US$350) per computer class per year x 290 computer classes equals about R3 (US$101,500).
2. Computer maintenance service: is about 5 percent of equipment cost (3,600 computers x R30,000 per computer) and equals R5.5 million (US$183,350) per year.
3. Computer upgrade: is about 10 percent of equipment cost per year and equals R11 million (US$366,700).
4. Teacher training: 146 teachers per year x R3,450 (US$115) per teacher equals R503,700 (US$16,800).
5. Additional school ICT staff salary: 146 staff members x R4,500 (US$150) per month x 12 months equals R7.88 million (US$262,800).
6. Internet traffic: R850,500 (US$28,350) per month x 10 months = R8.505 million (US$283,500).

Annual running expenses are about R36,400,000 (US$1.2 million) or less than 3 percent of municipal budget expenses for education in 2001 and 86 percent of the budget for the municipal E-education program for 2001–2003.
This is definitely a very rough example, but it gives an impression of the scale of the “demand” and “supply” gap. It also shows the importance of estimating on every level the total demand for funding needed to introduce ICT into the education system.

**Donors’ Funds**

In 1995, the Open Society Institution financed some computer supplies for general schools in Krasnoyarsk city. For example, school # 106 got a computer class with ten computers on base i486 processors. This class still operates with good efficiency as the school bought a modern server, and now its capacity is used to support “weak” computers with 486 processors joined in a local network (so called “thin client” technology). There are many examples of donors’ support in the area of introducing ICT in schools.

**Schools’ Nonbudget Incomes**

According to interviews, schools use a lot of their nonbudget income to fill in the gaps between budget financing and actual ICT related demand. Almost all expenses for supplies, Internet traffic, maintenance, additional payments to teachers, and ICT assistants for overtime work with students in computer classes are covered from schools’ nonbudget incomes. According to our interviews, quite often headmasters consider computer equipment as a priority in school nonbudget expenditures.

An interesting example was presented in rural school # 4 (village Berezovka), where parents collected money for 5 computers to be installed in the school.

**Private Sector Support**

Nowadays, another workable way for schools to get modern computer equipment is to win it in various kinds of student scientific competitions with prizes provided by the local business community. Examples are the competitions i) “Soft-Parade” held by the Internet center of the KSU and KrasInfoCenter, the regional center of ICT integration, with the support of local computer firms; ii) Krasnoyarsk State Technical University student software competition; iii) children’s computer festival with the support of the Children’s Additional Education Center, and etc.

Some computer traders give additional discounts for schools (together with existing offers for purchases in a bulk). But those examples are more exclusions then common practice. A possible solution could be to establish a down-payment (installment selling) system for educational organizations. But the solvency of schools is a big issue that stops traders. Moreover, as businessmen noted in interviews, they are not interested in donating computers to schools on a legal basis, as such transactions are taxable at a rate of 20 percent of the equipment cost.

**Funding the Introduction of ICT into Education: Conclusions**

Regional and municipal authorities understand the importance of investment in integrating ICT into the education sector. But they realize that without external support it is impossible for them to provide the appropriate level of computer supply. Current regional and municipal initiatives show that it is possible to make a breakthrough in equipping general (and IV) education institutions with computers. However, assistance is needed for further development.

Furthermore, IVE is excluded from the process of integrating ICT into education and gets no budget funding for that purpose.
Quite often, if a school has an opportunity to invest nonbudget income in ICT, it does so. In this way, the digital divide between rich and poor schools is increased.

The business sector gives some support and cooperation to schools. Some legal incentives (tax remissions) would help a lot in motivating it for more active involvement.

Schools do not get regular financial support for computer related expenses: upgrade, maintenance, and supplies, which decreases the potential for using ICT in education.

**Software and Content**

The following sections discuss the software available in the region for operating ICT-based teaching and learning.

**Standard Programs**

MS Windows of different modifications and DOS are the present operating systems. School computers normally are equipped with MS Office packages, standard software to work with graphics and images (Corel Draw, Photoshop, Adobe Acrobat, Fine Rider), presentations (PowerPoint), web-browsers (Internet Explorer, Netscape Navigator), specialized programs (PageMaker for making school newspapers, AutoCAD for working with graphics in specialized IVE institutions, etc.) if they respond to minimum software requirements. Old computers often run such old fashioned word processing programs as “Slovo i delo”, “Lexicon,” etc.

Usually a school gets licensed software only with the initial supply of equipment. According to the data of regional education administration there is no other licensed modern software in schools at all. The rest of software bought is pirated, and it causes a lot of problems with maintenance and compatibility. One can buy a pirate CD with a set of software for R90–150 (US$3-5). A total cost of such set of software on the legal market could be over R15,000 (US$500).

**E-Learning and Teaching Materials**

Educational CD-ROMs are not widely spread. According to series of interviews with general and IV schools’ teachers and administrators there are several reasons for that. They are as follows:

- Teachers have insufficient knowledge of how to incorporate e-learning materials into teaching practice.
- There are too few computers for all students from one class to work with e-learning materials at the same time.
- There is no relevant equipment; for instance, overhead and multimedia screen projectors could greatly help a teacher if there are too few computers in a classroom for every student to have one at the same time.
- There are no local networks to run CD-ROMs with shared access.
- Teachers consider the content and interface of existing educational e-learning materials as not appropriate for their requirements and expectations.

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8 Program for introducing ICT to regional education.
• Teachers are not made aware of new developments in the field of educational e-learning materials.
• Schools have no money to buy educational CD-ROMs and find them unreasonably expensive.

There are no special libraries equipped with educational CD-ROMs. The central regional library has a computer class where a set of CDs is available to a wide public but the number of public use computers with CD drives is quite limited (not more than ten). Moreover, school students are not allowed to use these library facilities. Sometimes advanced schools organize media libraries according to teachers’ and/or students’ needs. However, not more than 10 percent of these media library funds consists of licensed CDs.

District education specialists (for instance, in the rural district of Berezovskiy) note a lack of educational software in different subject fields as well as reliable and authoritative computer programs for management of educational institutions.

Figure A1.3. Types of E-Learning and Teaching Materials and Internet Resources that have been Used in General and IVE Schools (percentage of teachers using the resources)

Figure A1.3 illustrates types of e-learning and teaching materials and Internet resources that have been used in general and IVE schools.9 Most regular users of e-learning and teaching materials are teachers in general schools, and most popular materials are e-tests. IVE teachers are very rare users of such resources. Development games and e-learning software are rather popular in general schools. Internet resources are not used by teachers at all.

Source: Survey of teachers.

Own Developments

About 300 different titles of e-learning materials are developed in the region by HEIs at the moment. However, only 13 percent are targeted to a wide audience; the rest are focused on the specific needs of a particular education organization. For instance, they may put the quantum dynamics exam questions of an HEI in digital form. Every HEI develops e-learning materials, but most of them are digitalized books, monographs, and texts of lectures.

The situation with school teachers is similar. Quite often they develop their own e-learning materials. Their reasons are among the following:

• They do not find on the market any materials of satisfactory quality or that can be adapted to their courses and their students.
• They have insufficient information about existing e-learning materials.
• They want to experiment and find developing their own materials fascinating and useful.

9 Data source: sociologic study conducted in the framework of the case-study preparation.
Also teachers develop e-learning materials as a part of project work with students. For instance in city school #102, students of grades 5 to 11 take part in their own school projects in such subjects as history, geography, and literature. The school has only one telephone line, which makes it really hard for children to use Internet resources at school. However, computer class (eleven computers) is open till late and on weekends and students spend a lot of free time there to carry out their projects.

Most of the developments created by individual teachers or their classes are simple and do not look for any official status or license. Often they are multiple-choice tests for evaluating students’ academic achievements in concrete subjects. Sometimes they are PowerPoint presentations devoted to a topic from concrete subject.

The instructional design capacity of the region is very low. There are no firms specializing in the development of e-learning materials and those produced by HEIs or individual teachers have very limited value in terms of instructional design.

**Internet Resources**

Internet resources are almost unused at school level because of poor Internet access. A number of Internet resources have been developed in the region starting from websites of education institutions and coming up with telecommunication projects, children’s conferences, and sites devoted to general school curriculum.

**Educational Software and Content: Conclusions**

The region has great need of the following: i) methodological and information support for teachers who use ICT for education; ii) reliable distribution system for e-learning materials’; iii) reliable information about content and price of existing e-learning materials and those that are under development; iv) support for teachers developing original e-learning materials and support in instructional design.

**Use of ICT in Education**

If the resources are there, ICT can be used across the board for efficient teaching and learning. Figures A1.4 and A1.5, below, show the share of time spent on different activities by an average computer class in the two different types of education institution.

**Figure A1.4 Share of Time on Different Activities by an Average Computer Class in an Urban General School**

**Figure A1.5 Share of Time on Different Activities by an Average Computer Class in an Urban IVE School**
It is clear from the figures that in both general and IVE schools, equipment is mainly used for teaching informatics lessons and that an insignificant amount of time is spent teaching other subjects. In IVE schools no time is used for optional classes and much more time than in general schools is spent on specific vocational subjects.

Many of the teachers interviewed find that time in a computer class for their individual work (e.g., lesson preparation) is almost not available, and only 10 percent of urban and 25 percent of rural teachers can use computer facilities at any time.

According to interviews, most regular users of computer classrooms are high school students. This is because informatics lessons are taught mainly to them.

**Teaching ICT as a Separate Subject**

*Existing options.* The following are the two options of teaching informatics currently available:

1. A technically oriented approach teaches ICT as a compulsory theoretical and strongly specialized subject with a focus on programming languages, etc.

   **Box A1.6 ICT as Taught in Cadet Schools**

   For example, in Krasnoyarsk cadet school, students are taught programming languages from 5th till 11th grade, and that is the only way in which information technology (ICT) is introduced to them. Almost all the capacity of the computer classroom is used for this type of technical training.

2. A task oriented approach teaches ICT with the goal of giving the students skills (professional / personal / educational) they need to apply in life outside school.

   **Box A1.7 Task Oriented Teaching of ICT**

   One example is gymnasium #1, Univers. There specialized subjects and programming languages are taught as optional courses. Some of them are part of computer club activities and are chargeable. Students are very interested in attending those extra classes especially since the fee for the club is quite affordable – about R150 (US$5) for sixteen lessons per month. Usually there are six to ten students in the computer club classes, while during normal lessons, there are about thirty students.

The following table (A1.2) illustrates the level of students’ ICT skills. It shows that there is growth in these skills from 9th to 11th grade, that the level of computer literacy among urban and rural students is almost the same, and that Internet literacy varies a lot. These data do not provide information about the quality of the skills.

**Table A1.2. Students’ ICT skills (percentage)**

<table>
<thead>
<tr>
<th>Student</th>
<th>Can work with computer (%)</th>
<th>Can work with Internet (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th grade total</td>
<td>66.6</td>
<td>25.0</td>
</tr>
<tr>
<td>Urban area</td>
<td>67.0</td>
<td>30.9</td>
</tr>
<tr>
<td>Rural area</td>
<td>65.3</td>
<td>10.0</td>
</tr>
<tr>
<td>11th grade total</td>
<td>74.5</td>
<td>17.6</td>
</tr>
<tr>
<td>Urban area</td>
<td>74.4</td>
<td>20.9</td>
</tr>
<tr>
<td>Rural area</td>
<td>75.0</td>
<td>8.0</td>
</tr>
<tr>
<td>IVE total</td>
<td>41.2</td>
<td>9.4</td>
</tr>
<tr>
<td>Urban area</td>
<td>44.1</td>
<td>10.8</td>
</tr>
</tbody>
</table>
The majority of teachers and students of general and IVE schools in urban and rural areas cite the absence of a home computer as the main obstacle to developing ICT skills. Administrators cite the lack of time, which indicates that they do not consider developing ICT skills as a priority.

Use of ICT for Teaching Other Subjects

ICT is very rarely used to teach subjects other than Informatics. Almost all teachers and school administrators note the scarcity of methodological materials for using ICT as a teaching tool for academic subjects. Among rare examples, English language lessons were those met more often. This is because there are a lot of e-learning materials dedicated to the subject, and they are quite easy to use (usually simple texts, audio records, and tests).

Use of ICT for Specific Vocational Training

Unfortunately, however, ICT is not widely used in initial vocational training in Krasnoyarsk. This is mainly because the IVE sector has such poor computer equipment. In Krasnoyarsk city professional lyceum # 56, for example, students still get training in typing and word processing skills on typewriters. Although 24 percent of instruction time in the computer classes of urban IVE institutions is spent on professional skills training, only 7 percent of urban IVE teachers use e-tests, and only 2 percent use e-textbooks in teaching practice.

Out-of-school programs

There are sixty-five specialized additional education organizations providing ICT related activities for more then 14,000 students, including eighteen percent from rural areas. In urban areas, opportunities for computer experience can be found informally in private commercial computer clubs/cafés or through subsidized or free classes established by charitable (donor) funds/organizations. Most such clubs and classes have access to the Internet and are well equipped with hardware and software as well as with printers and scanners.

Private clubs have very popular gaming services (provided by local or global networks). They charge visitors as much as R9–15 (US$0.3-0.5) per hour for the use of a computer and the local net and R15–30 (US$0.5-1.0) for Internet access, depending on the time of the day. Although the activities of private clubs can have positive effects on children’s mastery of general ICT skills, educational institutions (as well as regional authorities) obviously have no real control over what the children learn, and the clubs can also pose a risk for children.

The organizations specializing in additional education run courses in general ICT literacy, web technology, programming, multimedia design, and publishing, basing almost all the courses on instruction materials developed by local teachers. Some courses are based on teaching and learning materials developed by Russian experts (for instance, LogoWorlds and RobotLandia). Unfortunately, however, there is a general lack of standard high quality courses.

An interesting best practice example is provided by four Children’s Additional Education Centers (CAECs) that are examples of well developed organizations for additional education focused on child-oriented ICT. The main ideas behind their system are as follows:
• Each center specializes in one area of education information technology.
• Contributions are welcomed from institutions of higher education anywhere in Russia that are interested in a center’s particular specialization. Centers are supposed to provide their own funding from sources that can include regional or municipal budgets, trusts, grants, and their own incomes. Some centers are functioning without any financial support from regional or municipal educational authorities.

Box A1.8 Children’s Additional Education Centers (www.docentr.ru/)

In the Children’s Additional Education Centers, there are 1,500 students, 100 computers (and most of them are modern – the centers annually get two computer classes from nonbudget incomes), about 60 ICT and 8 Internet oriented courses in the four CAECs. Teaching staff are highly qualified and professional. Children pay R400–600 (US$13–20) per month for a course and 400 students get education free of charge as they are financed from the municipal budget. Most of the centers’ incomes are nonbudget (for instance, centers get great support from 10 out of 50 Krasnoyarsk computer companies). Two CAECs have 256 Kbps Internet access via fiberoptic lines (each center pays R6,900 (US$230) per month, which is a very special price), two have dial-up and it will be swapped for fiberoptic in a couple of months. Two classes provide public Internet access for six hours a day. CAEC is heavily involved in a set of unique project activities including a computer summer school, a computer festival, online chess competition, etc. Technical assistance including work of specialists, supplies (unlimited use or use as much as one needs), and spare parts for equipment costs about R40,000 (US$1,330) per month per 10 computers.

There are examples of cooperation between some schools and these centers. For example, general school #36, situated next door to one of the centers, has poor computer equipment and uses the center’s ICT capacity for informatics classes, etc.

ICT in Education: Conclusions Regarding its Use

ICT is poorly used in education in the region. The state curriculum gives no clear directives for schools on how to implement and develop the use of ICT in education. So each school chooses its own way. Use of ICT could be stimulated by active exchanges of experience among teachers and administrations inside and outside the region; it could also be enhanced through examples of best practice demonstrated together with methodological support.

IVE schools have such poor equipment and such a lack of expertise that they scarcely use modern ICT for education purposes.

There are opportunities for students to study ICT and implement ICT skills outside a school. The potential of this sector is really high but not used to its full extent.

Distance Education

The regional education administration is building a distance education system on the following basis:

• Paper (traditional mail) based technologies
• Audiovisual technologies
• Electronic materials
• Internet technologies

There are no distance schools in the region that teach the general school curriculum and award official general school diplomas. A number of correspondence schools provide additional training in school subjects but the certificates they give have no formal status and act only as evidence of additional education been taken.
Distance Support Programs for General School Students

There are more than ten organizations in Krasnoyarsk that specialize in providing distance programs in extra curricula education for general school students. They are concentrated in urban areas in the central part of the region and have about nine or ten thousand students. Some courses fall within the general school curriculum and some are oriented to advanced and motivated students. Most are in the traditional mail based format, except ICT focused courses, which are mainly in the form of telecommunication projects. The main source of funding for these organizations is nonbudget income.

Box A1.9 Distance Education for Natural Sciences

| ZENSh, the distance education school for natural sciences, which is within the education department of Krasnoyarsk region, runs correspondence based courses in six school subjects. The number of students (year 2001) was 4,042, and 20 percent of them from rural areas. The number of students has grown 2.7 times since 1999, perhaps because graduates of ZENSh have some advantages in gaining entry to Krasnoyarsk State University. The school gives instructions in order to fill gaps in the general school education and to provide enrichment in certain subjects for advanced students. The real cost of education for one student is about R780 (US$26) per year but students pay only about R150 (US$5) per year per subject and the rest is paid 50 percent from the regional budget and 50 percent from nonbudget sources. ZENSh has an Internet site, which is quite often, according to a mini survey, people’s first source of information about the school. However, during the last two years only five students have used email to communicate with teachers. Basically every course (textbooks, tests, etc.) is available in electronic format, and ZENSh plans to run one pilot course in e-form soon. The school director stated that they would save about R100,000 (US$3,300) per year, widen the geographic range of the school, increase the number of students, and escape some routing paper work if all study processes were based on ICT. But there are some problems to overcome. First, teachers are not ready to use computers for education (and about one-third of them lack the ICT skills). Second, students do not always have easy access to Internet and email. Third, methodological questions still have to be resolved. For instance, a technique for checking exam papers in e-format is still to be considered foolproof. |

Most Krasnoyarsk HEIs have distance education courses for entrants oriented to training needed for entrance to the institution. All of them are paper correspondence based.

Krasnoyarsk Pedagogical University (KPU) has a program for gifted students called the School of the Future. It gives extracurricular distance education to school students (grades 1–11) from nine cities of the region. The education is open, partly based on ICT (using the Electronic Internet Textbook, making telecommunication projects, and using computer based performance control). The education model consists of i) a traditional class-lesson component; ii) a team projects component; iii) an intensive learning component; iv) a boarding school for selected gifted children. The tuition is R60 (US$2) per month for one subject.

Initial Vocational Education Distance Programs

There are no special distance education programs for IVE students.

Distance Education: Conclusions

The region has a huge territory and a large number of school age children living in remote areas. In this situation, where the access to extended education opportunities is rather limited, distance education can solve the problem. There seems little likelihood of being able to shift correspondence based instruction to ICT based distance education in the near future, although the advantages of such a move seem to be realized by correspondence school management. The main obstacles to that shift are poor technical
conditions, lack of instructional design capacity and quality e-learning materials, conservatism of teachers, and methodological and legislative barriers.

Home Computers

According to estimates by the Krasnoyarsk municipal education administration, about 10 percent of school students have access to computers at home and 30 percent of that group have access to the Internet. Table A1.3, below, reflects sociological research performed for the region as a whole, as a part of the case-study; it separates the data for the number of students with home computers and the number of them connected to Internet. Figure A1.6 shows the percentage of students with home computers only.

Table A1.3. Students with Home Computers and Access to the Internet (percentage)

<table>
<thead>
<tr>
<th>Student</th>
<th>Have a computer at home (%)</th>
<th>Have Internet access at home out of total students (%)</th>
<th>Have Internet access at home out of those students who have computer (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th grade total</td>
<td>24.4</td>
<td>8.1</td>
<td>36.0</td>
</tr>
<tr>
<td>Urban area</td>
<td>28.8</td>
<td>10.5</td>
<td>36.0</td>
</tr>
<tr>
<td>Rural area</td>
<td>12.9</td>
<td>1.8</td>
<td>14.0</td>
</tr>
<tr>
<td>11th grade total</td>
<td>30.4</td>
<td>11.7</td>
<td>41.0</td>
</tr>
<tr>
<td>Urban area</td>
<td>39.5</td>
<td>16.0</td>
<td>41.0</td>
</tr>
<tr>
<td>Rural area</td>
<td>5.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>IVE total</td>
<td>7.6</td>
<td>2.1</td>
<td>29.0</td>
</tr>
<tr>
<td>Urban area</td>
<td>8.4</td>
<td>2.4</td>
<td>29.0</td>
</tr>
<tr>
<td>Rural area</td>
<td>2.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Survey of students.

Figure A1.6 Students with Home Computers Only (percentage)

Source: Survey of students.

In students’ families, children are those who use the computer most actively. About 30.9 percent of 11th grade students use computers more than three hours a day (the average figure is 2.3 hours a day). In Moscow 56 percent of high school students use computers about 3.2 hours a day (the average figure is 1.2 hours a day). It appears that computer activity by urban high schools students whether in the capital city or in regional big cities is more or less equal, mainly because of the availability of home computers. However, for rural students, the story is different. In Krasnoyarsk region, only 19.3 percent use computers more than three hours a day.
For from 80 to 100 percent of students, the main purpose of using home computers is for entertainment and computer games (see figure A1.7). However, the home computer is often used for preparing for school classes and for additional education. Those who access the Internet from home are mainly urban school students, and 25 percent of them call it their usual activity on computers. However, only from 29 percent to 41 percent of urban students get their home computers connected to Internet. Rural students have far fewer opportunities for connection and do it very rarely. Usually it is on the children’s initiative that home computers get connected to the Internet.

**Figure A1.7 Usual Activities Performed on Computer**

<table>
<thead>
<tr>
<th>%</th>
<th>Preparing for school</th>
<th>Additional</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th grade (urban area)</td>
<td>43</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>9th grade (rural area)</td>
<td>36</td>
<td>36</td>
<td>9</td>
</tr>
<tr>
<td>11th grade (urban area)</td>
<td>59</td>
<td>81</td>
<td>65</td>
</tr>
<tr>
<td>11th grade (rural area)</td>
<td>19</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>IVE students (urban area)</td>
<td>45</td>
<td>25</td>
<td>12</td>
</tr>
</tbody>
</table>

**Source:** Survey of students and parents.

Of 11th grade students in both rural and urban areas who have home computers, about 40 percent are asked by teachers to use it for educational purposes. Of other students, only 14 percent of those in 9th grade in rural areas and 25 percent of those in urban IVE schools get the same requests.

Internet access is not required by teachers at all except for 17 percent of 11th grade urban students.

For families, however, the main purpose in buying a home computer is children’s education (see figure A1.8). The only exception is families of urban IVE school students who bought computers mainly for entertainment. Of those who bought computers for education, 79 percent of urban and 67 percent of rural general school students’ families and 57 percent of urban IVE school students’ families have educational software installed. The programs are mainly school subject related and include encyclopedias and dictionaries. English language programs are quite popular, especially among rural students.

**Figure A1.8 Distribution of Families Buying Home Computers for Education**

Despite lack of encouragement by teachers, educational sites on the Internet are visited by 93 percent of 11th grade urban students, 37 percent and 31 percent of 9th grade students in urban and rural areas, and 50 percent of students in urban IVE schools. Communicational sites (Internet chats and forums) are less popular except among of 9th grade urban students. It is interesting to note that less than a half of all students (except 79 percent of 11th grade urban students) visit entertainment sites. Unlike
computers Internet is not often used for entertainment.

*Source:* Survey of parents.

About one-third of general school students’ families pay less than R150 (US$5) per month for Internet access, 35 percent pay from R150 to R500 (US$17) and the rest pay from R500 to R1,000 (US$33). Only three percent of families can afford more than R1,000 for Internet access.

Table A1.4 illustrates the proportion of general and IVE school teachers and administrators that have home computers. IVE administrators are not presented in the table as the number in the sample was too small.

### Table A1.4. Teachers and Administrators with Home Computers (percentage)

<table>
<thead>
<tr>
<th>Staff</th>
<th>Have a computer at home (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General school teachers total</td>
<td>20.0</td>
</tr>
<tr>
<td>Rural area</td>
<td>5.1</td>
</tr>
<tr>
<td>Urban area</td>
<td>24.8</td>
</tr>
<tr>
<td>IVE teachers total</td>
<td>8.7</td>
</tr>
<tr>
<td>Rural area</td>
<td>-</td>
</tr>
<tr>
<td>Urban area</td>
<td>10.0</td>
</tr>
<tr>
<td>General school administrators total</td>
<td>17.9</td>
</tr>
<tr>
<td>Rural area</td>
<td>11.8</td>
</tr>
<tr>
<td>Urban area</td>
<td>28.6</td>
</tr>
</tbody>
</table>

*Source:* Survey of teachers and administrators.

These computers are mainly used by family members. If teachers and administrators themselves use their home computers, it is usually for professional purposes, including for self-education. The latter applies to half of urban general and IVE teachers. A quarter of urban general school teachers get Internet access, and they are the only staff members who use home computers for e-mail (16 percent of all teaching staff).

Teachers’ incomes are usually very modest. The region is, therefore, far from being able to assume that every teacher’s family can afford to buy a computer. Here in the box is an example of how this problem can be solved.

### Box A1.10 Encouraging Teachers to Buy Computers

*There is an initiative to give teachers special loans to buy computers. At the Univers Gymnasium, for example: 23 computers were bought for R370,000 (US$12,330) for school teachers in 2001 and they will pay this money back in 12 months (without interest). For comparison, note that the average teacher’s monthly salary is about R3,200 (US$110) while the bulk purchase reduced the price of each computer by almost 15 percent.*

**Home Use of Computers: Conclusions**

Home computers are fairly normal pieces of equipment in the households of general school students, especially in big cities. (Data from Krasnoyarsk city can be assumed to apply to other big cities.) Rural students’ families do not have the same financial opportunities for buying computers, raising the issue of the digital divide. This is caused by the geographical distribution of human settlement and cannot be bridged by ICT access in other places such as computer clubs or centers providing Internet access, which are also concentrated in urban areas.
School teachers as a rule ignore the resource of students’ home computers. However it is common for children to use home computers for educational purposes. They use educational software and Internet sites.

Not many school teachers have computers at home, but those who do use it for professional purposes. Home computers should be considered as significant educational resource, especially teachers’ home computers.

**Human Resources**

It is commonly understood that teachers and administrators in general are not ready to implement ICT in education. There is a lack of school teachers and of administrators well trained in ICT and able to use it for general purposes as well as for education (see table A1.5). For example, staff of the Federation of Internet Education (FIE) noticed that they have to train school teachers in the basics of ICT before introducing them to Internet technologies.

**Table A1.5 ICT Literacy and Use among General School and IVE Teachers (percentage)**

<table>
<thead>
<tr>
<th></th>
<th>Urban school teachers</th>
<th>Rural school teachers</th>
<th>Urban IVE teachers</th>
<th>Rural IVE teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Those who can work with computer (percentage)</td>
<td>44.6</td>
<td>46.2</td>
<td>35.0</td>
<td>33.3</td>
</tr>
<tr>
<td>Those who use computers in their profession (percentage)</td>
<td>29.8</td>
<td>23.1</td>
<td>20.0</td>
<td>16.7</td>
</tr>
</tbody>
</table>

*Source: Survey of teachers and administrators.*

Urban teachers identify lack of time as the main obstacle to ICT use. Another problem is that skillful informatics teachers and ICT assistants leave the education sector for the private sector because of i) low salaries; ii) poor technical characteristics of computers in schools that stop them from implementing their deep knowledge and modern techniques in practice.

**In-Service Training**

The percentage of teachers ever trained in ICT is presented in figure A1.9. The interesting fact is that most of the teachers interviewed did not name the institution that provided training for them. All teachers named self-education as the dominant way of getting ICT skills. This means that in spite of the fact that many teachers received ICT training they do experience a need to improve their knowledge and skills.

Analysis of teachers’ basic skill level in ICT shows that 29 percent of teachers have some skills in working with MS Windows, 23 percent and 14 percent are familiar with MS Word and Excel respectively, and less than 2 percent of interviewed teachers have ever browsed Internet.

**Figure A1.9 Teachers Trained in ICT to Date (percentage)**

Education administration officers estimate that about 8,000 general school teachers need ICT training. This is close to 25 percent of the total number of teachers. Taking into account the cost of a ten-day course of training 50 school teachers in ICT is R175,000 (US$5,800), the overall cost for 8,000 teachers would be R28 million (US$933,000).
In-service training in ICT for general education teachers and administrators in the region is provided by both the government sector: In-service teacher training institute, and Krasnoyarsk pedagogical university; and the private sector: Federation of Internet Education (FIE) (http://www.fio.ru/).

Any teacher can get ICT training free of charge in the FIE, in a regional in-service teacher training institute and in Krasnoyarsk Pedagogical University. The remaining private sector organizations (for instance, Maxsoft Company (http://www.maxsoft.ru/), Inoprof institution, and etc.) do not provide special ICT courses for teachers and charge their students R1,500–R2,400 (US$50–80) for a 40–60 hour course for PC users (MS Office and Internet).

**FIE.** FIE is focused on training in Internet technologies for school teachers and administrators. It is financed by the YUKOS Oil Company and provides students with a full refund for all expenses (tuition fee, accommodation, meals, transport). It trains 1,400 school specialists per year.

**In-service teacher training institute.** This institute provides regular courses for teachers of ICT as a separate subject. It provides training for 400 school specialists per year.

**Krasnoyarsk Pedagogical University.** The university has two programs for retraining elementary school teachers: i) ICT in elementary school; ii) methodology of introduction course of ICT in grades 5–6 (thirty graduates a year for the two programs together). The university also trains school teachers and HEI professors in the following areas: computer technologies in pedagogical practice, multimedia technologies, design of multimedia pedagogical software, ICT in pedagogical practice.

Thus all in-service teacher training facilities are concentrated in the Krasnoyarsk city and a critical problem of high transportation cost arises for training teachers from remote areas.

**Preservice Training Provision**

Preservice training in ICT for general education teachers is provided by the following:

- Krasnoyarsk Pedagogical University
- Krasnoyarsk State University
- Pedagogical colleges

**Krasnoyarsk Pedagogical University.** The university has branches in four cities of the Krasnoyarsk region. It has a program for training subject teachers in elementary school to use ICT in teaching. It has an undergraduate program for teachers in which individual subjects are taught hand in hand with ICT in two profiles, as in the following: ICT and physics, ICT and mathematics, ICT and psychology, ICT and English, ICT and economics (total number of graduates is fifty per year). The university administration understood that the time had come to train subject teachers to be competent in ICT.

**Krasnoyarsk State University.** The university has a chair in ICT in Education within the department of pedagogical psychology, which produces twenty graduates per year.

**Achinsk, Kansk, and Krasnoyarsk pedagogical colleges.** Between the three of them, these colleges train sixty informatics teachers per year.
Development of Human Resources: Conclusions

Opportunities exist in both the government and private sectors for existing school staff and undergraduates to get trained in ICT for education purposes, but they are rather limited especially for school staff in rural areas. Expert estimates vary as to the quality of training available in different institutions – some specialists see it as good and some criticize it. That means the real demand for subject teachers as specialists in ICT is not yet developed, and there is no common understanding of requirements for qualification of such teachers. There is no systematic strategy for combining the training of subject teachers as specialists in ICT with the realities of introducing ICT into the teaching process.

There is a lack of continuing support for skilled teachers of ICT. Many teachers are self-trained in ICT and they need support, first, for further self-training, and second, for putting into practice the skills they have acquired. (An example of such support would be the means to exchange such experience with remote colleagues). The cost of such support can be less than traditional teacher education; providing both kinds of support should be considered as an effective way of developing human capital in the region.

The problem is compounded by there being little learning material for training teachers of various subjects as ICT teachers. The problem of certification of subject teachers as specialists in ICT is still to be solved.

ICT Programs in Education

ICT policy at every level is built around the following three objectives:

- Effective management of the regional education system
- Ensuring each child is accorded his or her constitutional right to education
- Effective human resource development.

Regional Level E-Education Program

Regional E-Education program has four targets, five main projected activities, and seven main projected outputs. The program is focused on introduction of ICT in general education for the years 2001–2004.

Targets

Objectives for regional E-Education program are as follows:

- To create ICT environment for education.
- To provide conditions for lifelong professional development of pedagogical staff by distance education.
- To create a network of district information resource centers.
- To supply schools with computer equipment, means of telecommunication, software, mediab-libraries (“mediateca”).

Main activities
Main projected activities for regional *E-Education* program are the following:

- Information support and program management
- Development of ICT in the regional education institutions, including:
  - Providing access to information resources for students and teachers
  - Creation of a basis for a distance education system
  - Material and technical support for educational projects
  - Development of teaching and learning materials.
- Increase of efficiency of educational services through network cooperation.
- Development and introduction of ICT based system of regional general education management.
- Equipment of ICT classrooms in conformity with hygiene and sanitary requirements and fire safety procedures.

### Main outputs

The main projected outputs of the *E-Education* program are as follows:

- 57 district resource centers equipped with modern facilities and channels of access to Internet.
- 57 multimedia libraries covering in some degree the lack of visual teaching and learning materials.
- 206 points of automatization of regional general education system management.
- Computer classes (11 workplaces) for schools in 16 of the most poorly equipped districts.
- Computer classes (6 workplaces) for schools in 16 of the well equipped districts.
- Sets of computer equipment and software for 110 computer classes providing services to children with special needs.
- Training activities in the educational use of ICT for not less then 5,700 educational specialists (including 3,600 from rural areas).

Total financing of the program from the regional budget is more than R137.6 million (US$4.6 million).\(^\text{10}\)

### Krasnoyarsk City E-Education Program

The following describes the municipal *E-Education* program in Krasnoyarsk city for the years 2001–2003.

### Targets

The program has the following four objectives for the introduction of ICT to education:

- Guaranteeing constitutional rights to modern education at every level through access to world information and education resources via local and global networks and distance education systems
- Establishing of ICT context focused on educational purposes as well as on interaction of educational institutions with social environment
- Student understanding of the role of ICT in the modern world

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\(^\text{10}\) By the time this case-study was completed, implementation of the regional program for introducing ICT had been frozen by the regional legislature, as most of the budget money was spent to raise teachers’ salaries.
• Defining invariable part of basic curriculum

Main outputs

The five main outputs of the program are as follows:

• The greater part of the city schools have been equipped and provided with technical support for the study process.
• A complete system has been created for teaching ICT to students of most city schools.
• The basis for open education and effective use of new education means has been established.
• A system of teacher training in educational ICT has been established;
• Base parts of information education network and education management system are created.

Total financing of the program from municipal budget is more than R42.4 million (US$1.4 million) for 2001–2003. Of this financing, 90 percent is being directed to establishing the technical capacity for introducing ICT to children’s education.

District (Rayon) E-Education Programs

Districts of Krasnoyarsk region are supposed to develop E-Education programs and get them approved by regional authorities by 2002. At the time this study was completed, none of these programs was fully developed and approved. Regional education authorities define the main framework for district programs. It is presented below.

Main Strategic Objectives

• Organization of an ICT environment for education within districts.
• Creation of district media resources.

Main Activities

• To create computer networks with Internet access in every school.
• To create district resource center providing methodological support and training for teachers in area of educational use of Internet.
• To create media libraries.

However, at the district level, drafts of the programs mainly refer to common financial difficulties and do not suggest convenient ways of tackling existing problems especially in light of concrete district particularities.

School Level E-Education Programs

School level ICT programs are very rare in the Krasnoyarsk region. Usually teachers and students are not informed about existing programs, goals, and tasks. School communities are not involved in preparation of the programs. There is no common understanding of the necessity for such programs.

ICT Programs in Education: Conclusions
There is no coordination of national and regional strategy for introducing ICT into education. That can quickly become a serious obstacle to achieving positive results from the introduction of ICT in education.

The regional program is poorly linked with the federal *e-Education* program and the municipal program in Krasnoyarsk city. An example of poor coordination is the assumption by these programs that e-learning materials and software will be developed on each level; however, the areas of responsibility are not defined, and there is a risk of duplicating efforts.

Where introduction of ICT into education is concerned, most decisions made at the regional level are based not on reliable data but mainly on experts’ opinion. This situation results from the fact that there is no ready-to-use complete and complex data for analysis, and most education information from different sources is contradictory and lacks comparability.

The programs are input oriented and do not consider the learning outcomes as a priority. The statistical and sociological bases for decisionmaking within the framework of the programs are not clear (not transparent). The priorities and demand for financing (amount of financing required to satisfy the needs of education sector in ICT) is not estimated. Wide systemic introduction of ICT into education supposes a significant change in teaching and learning practice and this idea is not reflected in the programs.

The programs are top-down oriented and poorly based on existing school level capacity and initiatives of teachers and private sector. The importance of public support for successful introduction of ICT into education is underestimated.
Appendix 2

Irkutsk Region Case Study

[Note: In the absence of ready-to-use complete and complex data for analysis, most information came from different sources and was not comparable. However, much information was collected, and most is up to date for December 2001 / January 2002. The main sources are the following: regional education department for statistics; data from a special study conducted as a preliminary to developing a regional program to integrate ICT into education; data from a special sociologic study conducted in preparation for the case-study; interviews with regional education specialists.]

THE REGION IN PERSPECTIVE

Territory

752.5 square km. Covers 37 districts.

Population

2,591,300 people live in the Irkutsk region.
Population of Irkutsk (Irkutsk region capital city) is about 591,200 people.

Economic Situation

The region contributes more money to the federal budget (in taxes, etc.) than it receives in benefits (transfers). There was slow economic growth in the region during 2001. Index of industrial growth for January-April, 2001 was 103.0 percent.¹

Educational Strategy

The Ministry of Education considers Irkutsk region as one of the advanced Russian regions in the field of education development. Wide positive experience of innovative schools has been accumulated there as well as advanced educational and scientific research capacity.

Priority in developing the region’s education system has been given to the following:

- Satisfying the constitutional right of citizens to quality education
- Preserving students health
- Protection of rights of orphans and of children without parental care.

Educational Statistics

Irkutsk region’s expenses for education during 2001 were R3,889.8 million (US$129.66 million) – 21 percent of consolidated expenses for the region as a whole. Salaries took about 49 percent of the consolidated education budget, and 1.3 percent was spent for equipment and other durable goods.

General Education Statistics (2001 data)

Total regional and municipal budgetary expenditure for general education: R1,822.4 million rubles (US$60.7 million) for 2001; 66.3 percent of funds was spent for urban schools.

¹ http://www.admirk.ru/adm_obr.htm
Total number of schools: 1,102, including 672 rural schools (61 percent) and 430 urban schools (39 percent).
Total number of students: 366,186, including 127,307 in rural schools (35 percent) and 238,879 in urban schools (65 percent).
Total number of teachers and administrators: 29,745, including 10,298 in rural schools (35 percent) and 19,447 in urban schools (65 percent).
Student/teacher ratio: in rural areas, 12.4; in urban areas, 12.3. The equal ratio is uncommon for Russia; usually the figure for rural areas is lower.
Average per capita cost of education in 2001: about R6,580 (US$220)² in rural schools; about R5,160 (US$170) in urban schools.

The Irkutsk region has three big cities, each with a well-developed infrastructure, economy, and financial sector, and they have elite, innovative schools with significant nonbudget income. There is one private school in Irkutsk city. Most other cities and districts are economically stagnant. The general education system in the three big centers is represented by regular general schools, gymnasiums and lyceums, some of the general schools are innovative.

Total number of extracurricular education institutions for school age students: 159, educating 115,000 students (31 percent of Irkutsk region total). Regional expenses for additional education are R314.9 million (US$10.5 million).
Total number of teaching staff and administrators of extracurricular education institutions: about 2,630.

The system of working with motivated children is well developed in the Irkutsk region. During the year 2001, two regionwide scientific conferences for general school students, as well as 22 regional Olympiads in seventeen subjects were conducted with total of 1,858 participants in both events.

Cadet Corps

Total number of cadet corps: There is one cadet corps in the Irkutsk region.
Total number of students: about 100
Total number of teachers and administrators: 36
Student/teacher ratio: 33.3.
Average per cadet cost of education: R42,900 (US$1,430)

Initial Vocational Education (funded from the federal budget)

There are three types of IVE institutions in the region: i) school (combining initial vocational and general education programs); ii) lyceum (combining advanced initial vocational and general programs); iii) art and craft house (only initial vocational education program).

The number of IVE students and graduates is growing.

Total number of IVE institutions: 57, including 11 rural schools (19 percent) and 46 urban schools (81 percent).
Total number of students: 21,576, of which 3,403 (16 percent) are in rural schools and 18,173 (84 percent) are in urban schools.
Total number of teachers and administrators: 1,087.

² Average cost for Russia is about R8,000 (US$270).
Average per capita cost of IVE in 2001: R16,823 (US$560)\(^3\) in urban areas and R17,977 (US$600) in rural areas. In addition to these costs significant expenses are met from the revenues of IVE institutions themselves, although the amount is hard to estimate as it varies from one school to another, and they do not make those sums known.

**Secondary Vocational Education**

This level of vocational education is funded from the federal budget and by branch ministries responsible for specialized fields of training.

There are two types of secondary vocational education (SVE) institutions in the region: i) college (combining advanced secondary vocational and general education programs); ii) technical school (combining secondary vocational and general education programs).

*Total number of SVE institutions by 2001*: 37, all of them urban.
*Total number of students*: 18,185.
*Total number of teachers and administrators*: 2,218.
*AVERAGE per capita cost of education in 2001*: about R17,000 (US$567).

**Higher Education** *(funded from the federal budget and private sources)*

*Total number of higher education institutions (HEIs)*: 26, including 15 state and 11 private
*Total number of students*: 101,448, including 87,902 in state HEIs and 13,546 in nonstate HEIs

According to the Ministry of Education rating, the Irkutsk State Academy of Economics is one of the top three economic HEIs in Russia.

**General Conclusions**

There is a high concentration of education institutions in big cities. Concentration in rural areas is low. Most general and initial vocational schools situated in remote and rural areas are small. Most privileged general schools (lyceums and gymnasias) are situated in big cities in wealthy districts.

There is a strong potential for human development in the Irkutsk region, both to preserve traditions of quality and to develop further capacity. Existing industry requires highly skilled workers and technicians, and the small and medium enterprises sector requires a vast set of skills not produced in sufficient quantity. The labor market is not yet sending a sufficiently clear message to the education sector but obviously both existing and emerging sectors of economy require an ICT competent workforce.

**ICT STATUS OF THE REGION**

The following sections look at ICT availability in the region. It starts with the ways in which access to networks from the classroom could be facilitated using telecommunications networks, institutional and regional networks, and the Internet. The section then moves to the distribution of hardware and software.

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\(^3\) Average for Russia is 5,975 rubles ($200)
**Telecommunication Infrastructure**

The following discusses proposals for introducing ICT into the regional education system using existing telecommunication infrastructure.

**Regional Telecommunication Networks**

Telecommunication infrastructure in the Irkutsk region is well developed; it includes national main digital lines passing through Irkutsk city as well as regional digital channels. The main lines belong to Rostelecom, Irkutskenergo, the East Siberian railway department or Transtelecom, and Electrosvyaz. These networks have a huge capacity for data transmission, including video data. Fiberoptic lines connect fourteen cities in the region.

A telemedicine project has been implemented within a regional socially oriented information telecommunication network based on modern information technologies. The telemedicine network connects medical institutions in eleven cities with a speed of up to 11 megabits per second (Mbps) and has enough capacity to be used for educational purposes.

However, there is a big difference in infrastructure development between big cities (especially in Irkutsk city) and small towns and rural areas. The last have almost no quality telecommunication lines and modern equipment. However, there are digital channels available that can be used for connecting the territories where 90 percent of the regional population is dispersed. Thus, the main challenge is twofold: first, to create telecommunication hubs providing high-speed connection with Irkutsk city via available channels and, second, to solve the last mile problem. The key to success can be found in the effective cooperation of regional and sectoral authorities, main telecommunication operators (private and state), and Internet service providers (ISP).

Regional HEIs have high capacity and extensive experience of the development and maintenance of telecommunication networks (see the section below on *Network Access to Digital Information Resources in Education* for details).

**Internet Service Providers**

Technical conditions for providing Internet access in the region are good.\(^4\) The Internet provider network of Electrosvyaz is available in most of the district centers.

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There are several Internet services providers (ISPs) in big cities, but in small towns or rural areas, their number is limited. Average cost for one-hour dial-up Internet access during daytime is about R20 (US$0.7). Electrosvyaz costs less (R18 rubles or US$0.6) for access in rural areas and small towns as it develops points of Internet access in rural areas. Quite often it is the only ISP in remote and rural areas, but unfortunately, so far, it covers only district centers.

Internet access via a dedicated line with 256 Kbps costs about R8,550 (US$285) for 4Gb of incoming traffic. Setting up a dedicated channel (up to 512 Kbps) costs from R450 (US$15) in big cities and up to R990 (US$33) in northern territories. Recurrent costs for a radio-channel set-up (with a speed of 11 Mbps) can be estimated as R65,000 (US$2,200).
Regional Telecommunication Networks: Conclusions

A considerable advantage of the manner in which it is proposed to introduce ICT (and Internet in particular) into the region’s education is that it will provide a vision of how the existing telecommunication infrastructure (as controlled by different sectors) can be used to serve education sector demands.

The main problems are 1) the vast territory of the region and the gap in access to high-speed telecommunication channels in different districts, 2) the lack of ISPs in small towns and rural areas, 3) the last mile problem.

Network Access to Digital Information Resources in Education

Access to educational resources on telecommunication networks is available at three levels: institutional, regional (cluster), and through the Internet.

Institutional Level

More than 50 percent of computer classes in general schools and most IVE institutions (as well as SVE and HE institutions) are connected in different local area networks (LAN). Educational content of such networks and services available for students and pedagogical staff is rather limited: small amount of administrative information, rarely updated teaching and learning resources, etc.

Regional (Cluster) Level

Irkutsk State University (ISU) created a 30 km long, 100 Mbps fiberoptic network in Irkutsk city and an 11 Mbps radio network to solve the last mile problem. It has experience in conducting educational video conferences and other educational activities by means of the network.

Irkutsk State Technological University, in cooperation with various organizations within the Irkutsk regional scientific and educational complex (IRSEC), has created an integrated network of 40 kilometers long with up to 1 Gb of fiberoptic backbone. It connects six HEIs, nine Russian Academy of Science institutions, and a number of other scientific and educational organizations. The network is made even wider by IRSEC’s agreement with the private ISP Business Network Irkutsk to use its local city fiberoptic infrastructure and by its access to the ATM network of “Irkutskenergo.” The Technological University has access to these facilities through the joint agreement with IRSEC, but for general schools and IVE institutions access is very limited.

Through the joint efforts of the regional administration, the Soros Foundation, and ISU, a regional target program to create a medical computer network for Irkutsk is being implemented.

Internet

About 75 percent of municipal education management departments have access to global telecommunication networks.

In schools, students have very limited access to Internet resources. Only about 25 percent of urban general schools have Internet access, and usually only one computer in a school is connected, by dial-up mode, the speed of which is usually only about 32 Kbps. Moreover, this is usually the only telephone line for a general school, 85 percent of which have no more than one line. Thus, the average time a school works on the Internet is about 12.3 hours per week. About 24 percent of IVE institutions have Internet access, all in
dial-up mode. Current potential for connecting general schools to Internet is presented in figure A2.2 below.

About 15 percent of all schools have e-mail. Normally it is used once per week or less, mostly to communicate with a couple addressees.

Internet traffic cost is paid from nonbudget incomes.

**Figure A2.2 Current Potential for Connecting General Schools in Regional Districts to Internet (percentage)**

* Percentages (y-axis) represent existing opportunities (from zero to one hundred percent) to connect general schools in selected regional districts to the Internet. Opportunities depend on availability of telecommunication channels, ISPs, and financial resources. Numbering of the selected regional districts on the x-axis is conventional.

**Source:** Estimate by regional education administration.

**Access to the Networks and Digital Educational Resources: Conclusions**

There is good potential for developing regional networks and using them for education. The last mile and the availability and demand for valuable (and viable) educational content are significant problems.

Many of the schools that have a computer class have a local area network. However, schools can seldom provide Internet access from every computer connected to a LAN. At the same time educational content available inside LANs often is very poor and schools have not yet worked out ways to increase it. These two facts make the value of such local networks for education very low.

These are just some of the reasons for the low usage of digital educational resources in both general and IVE schools. In addition, it can be explained by lack of ISPs, poor functioning of phone-networks, high prices for Internet traffic, lack of school funds to pay for them, and teachers’ lack of training in introducing Internet technologies into education.

Providing regional (cluster) educational networks with high quality content could help to reduce the cost of access to digital educational resources, as access to regional networks can be very cheap; it also could improve the quality of the access by increasing the speed and reliability of connection.

**Hardware**

This section focuses on availability and costs of computer equipment for students in different kinds of schools.
Equipment

13.5 percent of municipal education management departments have no computer equipment at all. Most of the available computers are used for office work and accounting and less than 1 percent of available computers are used by methodists – meaning teachers of teachers who provide in-service training. This is a barrier to effective professional communication and information exchange.

In schools, there were, by 1 January 2001, 7.3 computers per school or one computer per 65 students in the region; of these 68 percent were obsolete pieces of equipment (many of them not used at all), making the real ratio of up-to-date computers to students 1/203. About 5 percent of general schools did not have computers.

Figure A2.3 General Schools in the Region Equipped with Up-to-Date Computer Classes (percentage)

During the 2000–2001 academic year, this situation saw some improvement (see figure A2.3). Within the framework of regional and federal computerization programs (see details in section below on Sources of Funding), 2,584 computers joined to 269 computer classes were provided to the region. As a result, about 43 percent of general schools were equipped with modern computers (none less powerful than a Pentium II) in addition to those schools that already had up-to-date computers. 72 percent of new computer equipment was allocated to rural schools and 28 percent to urban schools.

Source: Regional education administration data

There are about 1,100 computers in IVE schools in the region. Average student per computer ratio is about 20 – in vocational school #46 the ratio is as low as 5. About 100 percent of IVE institutions (including pedagogical schools and lyceums) in the region are equipped with modern computers, and the computer classes are open for an average of 25.5 hours per week. As long as classes are open seventy-two hours a week, all IVE students will have access to ICT. Two factors affect access to ICT. The first is the type of educational institution – whether it is an “initial vocational school” or an “initial vocational lyceum”; the second is the type of professions /qualifications trained for in a given institution. Usually the lyceums have more computers and use them more actively in a variety of subjects, including professional areas. At the same time, students attending the first type of institution in order to get professions in areas requiring ICT skills also use computers on a regular basis. However, in reality usage in the average vocational school is about 35 percent and, in the average vocational lyceum, about 60 percent. These data can be explained by the following factors: the computer classes were recently installed (2001–2002 academic year), the pedagogical staff has just started using ICT in the educational process, and there are certain difficulties in providing Internet access.

Less than 20 percent of students in general schools with traditional educational programs have real access to computer equipment (ICT). This low figure can be explained by the fact that only high school students generally have classes in informatics and ICT support for general subjects. At innovative schools and experimental pedagogical sites, more than 60 percent have access to computers, and in gymnasias and lyceums, the figure rises to between 80 and 100 percent. (However, gymnasias and lyceums together equal less than 3 percent of all schools.) The research data show that the total number of students on surveyed
territories with real access to ICT is about 57 percent for city schools and about 25 percent for rural schools.

The research data demonstrate a difference in the number of students per computer between advanced, privileged, and normal schools as well as between rural and urban schools of different types (see table A2.1).

**Table A2.1 Number of General School Students per Computer in the Selected Geographical Areas**

<table>
<thead>
<tr>
<th>Type of school</th>
<th>Urban area (small town)</th>
<th>Rural area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools with traditional program</td>
<td>69</td>
<td>47</td>
</tr>
<tr>
<td>Innovative schools</td>
<td>48</td>
<td>38</td>
</tr>
<tr>
<td>Gymnasia</td>
<td>52</td>
<td>NA</td>
</tr>
<tr>
<td>Lyceums</td>
<td>20</td>
<td>NA</td>
</tr>
</tbody>
</table>

NA – not available

*Source: Survey of school administration*

In assessing the numbers given in table A2.1, it is important to bear in mind essential differences in operating conditions and total numbers of students in different types of educational institutions. The higher ratio of students per computer in the average general school can be explained by the fact that this category of schools includes 1-7 grades, unlike the Irkutsk gymnasia or lyceums. The average total number of students in rural schools is 300–500. Urban general schools average a total of 2,000 students.

**Access to and Use of Equipment: Conclusions**

The regional IVE system is comparatively well equipped with computers, and the level of computer equipment in general schools is higher than average for Russia. Current regional education policy gives hope for further improvements in this field, but there is a need for additional computers to equip work places of principals and administrators of general and vocational schools. The important decision defining the lowest generation of computer suitable for wide use in education was made by regional education authorities. In the future, it will make computer related statistics more transparent.

According to research data the gaps in ICT skills caused by schools’ modest means is compensated for by student access to computers in other places: students’ or friends’ homes, school resource centers, parents workplace, etc. This opportunity is much wider in urban areas than in rural districts.

Rural schools have enough computers to guarantee reasonable student per computer ratio. Thus, digital divide between rural and urban students in terms of access computers is not growing.

**Running costs**

All running costs can be split into two groups: 1) supplies and 2) maintenance service.

*Supplies.* The expenses for supplies (paper, printer cartridges, floppy disks, etc.) are not eligible for inclusion in calculating the provision of school funding from municipal or regional budgets.

*Maintenance service.* The expenses for computer maintenance are eligible for financing through the regional *E-Education* program, *Development of a common educational information space for Irkutsk Oblast for 2003–2005*. The funds allocated (R9.5 million – about US$410,000 – or about 15 percent of total financing of computerization during 2000–2002 and 5.7 percent of total financing of the program)
seems to be enough to satisfy the demand if the program comes into force as scheduled. Currently there is no specialized computer maintenance service for schools, and all schools obtain their own maintenance services directly from computer firms, generally using nonbudget funds; the cost of the services is hard to estimate at the school level, but in general the available nonbudget financial resources in schools satisfy only a half of the demand. Demand for maintenance depends on a variety of factors such as age of computers, intensity of use in computer class, degree of breakage, and so forth. Experts’ estimations indicate that maintenance needs at the school level reach 3-4 percent of equipment cost during the first year of operation and up to 10 percent after three years. Therefore, currently the maintenance service for computer equipment is problematic because of lack of financing and/or qualified specialists (especially in rural areas).

**Upgrading**

From 2005, the main activity of the regional education management department with responsibility for education computerization will be the upgrade of equipment supplied earlier.

Currently funding for upgrades is hard to plan and manage as it comes from nonbudget sources such as sponsorship and donations. Often the money gets spent with little accountability and schools do not always distinguish (count separately) expenses for computer maintenance from those for upgrading.

**Sources of Funding**

In 2000, for the first time in ten years, R54.4 million (US$2 million) were allocated in the regional budget for development of technical capacity of education institutions. This sum included R20 million (about US$700,000) to support the computerization of rural schools in 2000. As a result, 105 computer classes were established in regional general education and IVE institutions during the year 2000, including 1,010 workplaces for students and 104 for staff of general and IVE schools. Also in 2000, the federal program “Children of the North” provided two computer classes, and 353 computers were supplied using municipal budgets.

Within the federal program, *Rural School Computerization* (with 50 percent regional cofinancing) 166 computer classes, or 1,438 workplaces, for students and staff of general schools were provided during the year 2001. During 2000–2001 about R40 million (US$1.3 million) were spent from regional budget for rural school computerization. In 2002, the regional budget allocated R20 million to computerization of general education.

**Figure A2.4 Sources of Financing for General School Computerization**

<table>
<thead>
<tr>
<th>Federal budget</th>
<th>Regional budget</th>
<th>Municipal budget</th>
<th>Non-budget sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>7% (Municipal budget)</td>
<td>7% (Nonbudget sources)</td>
<td>18% (Federal budget)</td>
<td>68% (Regional budget)</td>
</tr>
</tbody>
</table>

Source: Regional education administration data

**Funding the Introduction of ICT into Education: Conclusions**

The most significant proportion of financial resources spent to introduce ICT into education has so far come from regional budget. However the share of nonbudget input can be increased and the business
sector may cooperate with schools and provide good support. Some legal incentives (tax remissions) will help a lot in motivating the active involvement of the business sector.

Schools do not currently get regular, solid financial support for such computer related expenses as upgrade, maintenance, and supplies, which reduces the incentive to use ICT in education, thus limiting the effectiveness of use of the equipment provided.

Software and Content

This section discusses the availability and compatibility of various kinds of educational software and efforts to develop it.

Standard programs

The operating systems in current use are MS Windows of different generations and DOS. School computers are normally equipped with MS Office packages, standard software to work with graphics and images (Corel Draw, Photoshop, Adobe Acrobat, Fine Rider), presentations (PowerPoint), web-browsers (Internet Explorer, Netscape Navigator), specialized programs (PageMaker for making school newspapers, AutoCAD for working with graphics in specialized PTU, etc.).

Educational Software

A set of educational CDs was supplied to every rural school that received computers within the President’s program for equipping rural schools. However teachers do not have methodological instructions on using those CDs in teaching. Another barrier to the active use of the available CDs is that students’ computers are not usually equipped with CD-ROM drives.

About 40 percent of schools in small towns and 20 percent in rural areas purchase CDs with encyclopedias, reference materials, simple e-textbooks and drills. (These are produced mainly by “1C-Repetitor” and “Kirill & Mefodii” educational software production companies for different subjects. The latter is described in appendix 4.) Especially popular are e-materials for learning foreign languages.

Most of the CDs used in schools are purchased by teachers and they are pirated (nonlicensed). Subject teachers as well as teachers of informatics in rural schools often face difficulties in trying to use electronic learning materials based on CDs because of incompatible software products or a limited number of CD-drives in students’ computers (most educational software is designed for individual user).

Box A2.1 Problems with Pirate Educational Software

The informatics teacher of a rural school in Shelekov district noticed that he struggles every now and then when trying to install pirate educational software and run it in a pirate copy of the Windows NT operating system.

Own Software Development

It is quite common in urban schools for teachers to develop their own educational software. About 40 percent of the schools situated in small towns and equipped with computers produce such software. Most of it consists of simple e-tests and drills in different subjects or PowerPoint presentations on narrow topics. Urban school teachers develop simple educational electronic materials even more often. Also teachers develop e-learning materials as a part of project work with students.
The main problem teachers face in developing educational software and in obtaining official status for its wider distribution outside their own classes is the lack of methodological support for integrating such ICT developments into daily teaching practice. To get official status, developed materials have to go through an expert review and be approved for use in education. An expert mechanism for that purpose is not completely organized yet, and there are not many professionals who are skilled enough to make conclusions in that field, so it takes a while for authorities to come up with final decision or with recommendations for improving a development.

Regional HEIs have experience in creating and using e-learning materials, but most are meant for specific higher education programs.

The Irkutsk In-Service Teacher Training Institute (IISTTI) develops a wide range of methodological materials to support the learning process and most of them are available on-line on a special web site.

**Internet Resources**

In general, students are not required to use Internet resources within the framework of the curriculum. Internet resources (where access is available) are mainly used for project activities. Collections of essays are popular among students, which is common for all regions of Russia. Advanced teachers use Internet resources to learn about new teaching practices, learning modes, and reference materials.

**Educational Software and Content: Conclusions**

Today, not all available educational software is fully integrated with traditional teaching techniques. Teachers need good methodological instructions to support their initiatives as well as reliable information about the content and price of existing e-learning materials. Locally produced e-learning materials would benefit if producers were trained in instructional design.

**Use of ICT in Education**

This section examines progress in the use of ICT in education and attitudes toward it throughout the region.

**Teaching ICT as a Separate Subject**

A regional component of the curriculum in informatics was developed and approved in 1997–1999. It includes an introduction course of informatics for primary school, which is taught in five schools and includes work with word processing software, spreadsheets, and graphics.

However, because of the absence of computers, almost 10 percent of general schools do not teach ICT as a separate subject (informatics) or teach informatics without computers. The absence of computers and/or trained teachers constitute the main obstacles to training in ICT, and this places pressure on the existing capacity of both computer classes and the teachers trained in ICT. There were more than 750 vacancies of informatics teachers in the region in 2001. Only about 55 percent of high school graduates had a basic knowledge of informatics in 2000.

**Box A2.2 Levels of Informatics Teaching**

Irkutsk City Lyceum has two levels of informatics teaching. The general level is compulsory for all high school students, and the advanced course is taught for whose with a special interest in that area. The advanced students regularly take part in interschool informatics competitions, and many students use ICT during a number of project activities in different subject areas.
Computer classes in general schools are mainly used for informatics classes and optional subjects (see table A2.2 below).

Table A2.2 Use of Computer Classes in General Schools

<table>
<thead>
<tr>
<th>Computer use in schools</th>
<th>Urban schools (hours per week)</th>
<th>Rural schools (hours per week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics classes</td>
<td>27–30</td>
<td>20–24</td>
</tr>
<tr>
<td>Other subjects</td>
<td>6–8</td>
<td>2–3</td>
</tr>
<tr>
<td>Optional subjects</td>
<td>16–20</td>
<td>5–10</td>
</tr>
<tr>
<td>Administrators’ work</td>
<td>1–2</td>
<td>NA</td>
</tr>
<tr>
<td>Teachers’ work</td>
<td>2–3</td>
<td>NA</td>
</tr>
<tr>
<td>Club activities</td>
<td>6–8</td>
<td>5–10</td>
</tr>
</tbody>
</table>

NA – not available

Source: Survey of teachers and administration

It is obvious from the table that computer classes are used mainly for informatics and that ICT is used very poorly for other subjects. Optional classes provide an opportunity for students to extend their knowledge of ICT to work in the usual school subjects and to work in such specialized fields as computer programming and web design. Such classes also give advanced teachers the opportunity to test and pilot the implementation of ICT in general education.

This increased use of ICT for teaching subjects other than informatics may have come about through the increased methodological support, aimed at the formation of new ICT thinking, that was provided to teachers during their pre- and in-service training. It may also result from increases in school computer equipment and the intensive implementation of a new generation of educational software.

Computer classes in urban IVE schools are mainly used for informatics classes (see table A2.3 below).

Table A2.3 Use of Computer Classes in Urban IVE Schools

<table>
<thead>
<tr>
<th>Computer use in class</th>
<th>Urban Schools (hours per week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics classes</td>
<td>20</td>
</tr>
<tr>
<td>Other subjects, including classes in professional areas</td>
<td>4–6</td>
</tr>
<tr>
<td>Optional subjects</td>
<td>4–6</td>
</tr>
<tr>
<td>Administrators’ work</td>
<td>NA</td>
</tr>
<tr>
<td>Teachers’ work</td>
<td>NA</td>
</tr>
<tr>
<td>Club activities</td>
<td>4</td>
</tr>
</tbody>
</table>

NA – not available

Source: Survey of teachers and administration

Use of computers during optional subjects (facultative) is not as active as in general schools, and the implementation of ICT for teaching professional skills is at the initial stage.

Use of ICT for Teaching Other Subjects

Project activities based on ICT and web sites building are rather common for general school in big cities. Students in almost every big city school equipped with modern computers and having Internet access take part in telecommunication projects.
Box A2.3 How an Experimental School Uses ICT

Experimental school #47 has three computer classes with every computer connected to Internet by dedicated channel. Low speed is still a problem, however. The school pays R2,000 (US$70) per month for connection and about R6,000 (US$200) for incoming traffic. ICT is widely used for project activities, for developing education in grades from 1 to 6, and for development of problem solving skills, web design, e-mail, and so forth. The approach is used when the computer is considered an effective instrument for performing various tasks in professional and educational areas. Teachers develop original electronic learning materials and give methodological support to teachers from other schools new to the use of ICT in the education process.

The opinion of teachers of different subjects can give important insights into the readiness of pedagogical staff (in terms of their capability) to introduce ICT into their teaching practice. This is especially true of informatics teachers as being the most advanced in technology skills; furthermore, up to 90 percent of urban and rural informatics teachers consider ICT methodology as a crucial professional skill for teachers in any field. The research data drawn on for table A2.4 show the priorities given to embedding ICT into school subjects by different groups of teachers.

### Table A2.4 The Subjects where ICT should beIntroduced First (teachers’ opinions in percentage)

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Urban teachers (%)</th>
<th>Rural teachers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science subjects</td>
<td>93</td>
<td>71</td>
</tr>
<tr>
<td>Humanities subjects</td>
<td>54</td>
<td>49</td>
</tr>
<tr>
<td>Subjects with great number of laboratory and practical tasks</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Integrated subjects</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>Teachers of physics, mathematics, chemistry, biology, geography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science subjects</td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td>Humanities subjects</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>Subjects with great number of laboratory and practical tasks</td>
<td>53</td>
<td>56</td>
</tr>
<tr>
<td>Integrated subjects</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Teachers of history and social science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science subjects</td>
<td>53</td>
<td>59</td>
</tr>
<tr>
<td>Humanity subjects</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>Subjects with great number of laboratory and practical tasks</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Integrated subjects</td>
<td>17</td>
<td>11</td>
</tr>
</tbody>
</table>

na - not available

*Source: Survey of teachers*

The unexpected results are that the importance of ICT in science subjects has almost unanimous recognition; all teachers underestimate a value of introduction of ICT into integrated subjects; nevertheless ICT is not considered by teachers of informatics to be a powerful tool for performing laboratory and practical tasks and for making virtual experiments. Absence of the need to implement the last of these activities during informatics lessons may be the explanation. At the same time more than 50 percent of urban and rural teachers of physics, mathematics, chemistry, biology, and geography consider ICT as a great aid for running experiments and doing laboratory tasks (which are important parts of studying these subjects). These teachers, unlike teachers of history and social science, have a vision of introducing ICT in their subject area. Research data show that about one-third of general schools in urban areas use ICT to support teaching in various subjects. That figure is higher among privileged and innovative schools.

### Use of ICT for Specific Occupational Training

81
In regional IVE institutions students study a course entitled “Informatics and Automatic Production” and get training in several professions requiring ICT skills, including console operator, accountant, secretary and consultant, cashier, etc. More than 350 titles of e-tests and 37 titles of learning software in specific and general education subjects are introduced in IVE institutions, and computers are used for writing term and diploma papers. However, pedagogical staff members have no tradition or wide experience of using the ICT in education and are in need of good quality systemic methodological support during this process.

Box A2.4 How a Vocational School Uses ICT for Professional Training

Professional lyceum #1 is an advanced market oriented vocational school. ICT is actively used in the educational process there to train students in professions that are in demand on the local labor market. For instance, during the interior design course students use computers to develop original parquet patterns or furniture; accountants are trained to work with modern professional software packages, and so forth. At the same time, a course of typewriting is taught on typewriters or out-of-date computers (both of which are often still in use in poor governmental offices). As a result, students of the latter need not occupy the facilities of modern computer classroom (which is scheduled to the limit by the other courses) and acquire skills still in demand and which can also be performed on modern computers. Graduates of the lyceum are in great demand on the labor market and there is a competition among entrants for admission, which is very uncommon for IVE. The lyceum gets great financial support from many leading local enterprises by providing professional retraining for their staff.

IVE schools in rural and urban areas do buy educational software, usually in the subject areas of chemistry, biology and mathematics; however, because it is inadequate to the tasks and priorities of vocational education, it is insufficiently used.

Out-of-School Programs

Since 1998, “ICT Week” has become an important regular event that facilitates introduction of telecommunication technologies in schools. Annually, school teams compete in a computer Olympiad within the framework of ICT Week. Evaluation criteria of this Olympiad are not the level of knowledge in school subjects, but the creativity based on ICT use. Regional ISPs sponsor the event and arrange free Internet access for the winners.

Since 1999, the Regional Education Center (REC) of the regional education administration has carried out innovation activity aimed at building up the education environment by means of distance, accelerated, and face to face modular courses on specific elements of different subjects, and on correspondence study. Potential consumers of these ICT-based general education programs in the Irkutsk region are the following:

- Graduates of middle school (grades 5–9)
- Those who have not received secondary education in due time
- Handicapped with limited mobility
- Those not compelled to attend schools, but wishing to confirm and upgrade their educational qualification (including convicted persons)
- Candidates for vocational schools admission
- Initial vocational schools students

In 2001–2002, REC and its five branches are implementing modular courses (by correspondence and by accelerated means through the use of multimedia technologies) in eight study groups in four towns of the Irkutsk region. Interviews with the students have shown that 84 percent of them are conscious of the need to purchase hardware and software to use at home for educational purposes; 74 percent have demonstrated extremely positive attitudes to the use of ICT in education; up to 47 percent prefer...
educational and communicational resources on the Internet. Basically, these preferences demonstrate that motivated students acknowledge the positive effect of using ICT for educational purposes.

In 2000–2001, REC in cooperation with Russia’s Ministry of Justice gave training in general education to twenty-eight convicted people, using multimedia technologies, and prepared them for receiving general education certificates.

Besides using purchased e-textbooks, REC uses its own original e-learning software developed for six subjects of general school curriculum. The center develops its own educational software instead of buying it on the market because it needs software that satisfies the demands of its modular and accelerated courses. A full package of multimedia learning and teaching, and testing software covering the school curriculum for grades 5-11 to be available soon, will include both its own developments in software and software purchased for the course.

**Risks and Obstacles**

The research data show that there is public understanding of the positive influence of ICT on the progress and socialization of students. Particularly notable is the optimistic attitude of parents of urban students toward the use of ICT by their children (see table A2.5). Almost half of them do not see any possible problems caused by ICT use, and for them it is a dual issue. Parents’ understanding of risks caused by ICT is presented in table A2.7. On the one hand, there is no exaggeration of negative effects of ICT and on the other hand, some negative aspects are ignored (for instance, mental and physical health). In rural areas parents are more cautious, but here, as in urban areas, there is no strict approach and there is no prohibition on their children’s use of ICT. Teachers’ views are roughly comparable (see table A2.6).

**Table A2.5 Evaluation of ICT Influence on Students’ Academic Progress and Socialization (parents’ opinions in percentage)**

<table>
<thead>
<tr>
<th></th>
<th>Urban (%)</th>
<th>Rural (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic progress</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitely positive influence</td>
<td>20.7</td>
<td>32.5</td>
</tr>
<tr>
<td>Likely positive influence</td>
<td>50.0</td>
<td>41.5</td>
</tr>
<tr>
<td>No influence</td>
<td>25.9</td>
<td>20.7</td>
</tr>
<tr>
<td>Likely negative influence</td>
<td>3.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Negative influence</td>
<td>0.0</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Socialization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitely positive influence</td>
<td>31.0</td>
<td>25.2</td>
</tr>
<tr>
<td>Likely positive influence</td>
<td>48.3</td>
<td>56.8</td>
</tr>
<tr>
<td>No influence</td>
<td>19.7</td>
<td>18.0</td>
</tr>
<tr>
<td>Likely negative influence</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Negative influence</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Source: Survey of parents*
Table A2.6 Evaluation of ICT Influence on Students’ Academic Progress and Socialization (teachers’ opinions in percentage)

<table>
<thead>
<tr>
<th>Academic opinion</th>
<th>Teachers of natural sciences (%)</th>
<th>Teachers of humanities (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive influence</td>
<td>59.7</td>
<td>59.6</td>
</tr>
<tr>
<td>No influence</td>
<td>27.3</td>
<td>24.4</td>
</tr>
<tr>
<td>Negative influence</td>
<td>3.4</td>
<td>6.0</td>
</tr>
<tr>
<td>No answer</td>
<td>9.6</td>
<td>10.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socialization</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive influence</td>
<td>67.5</td>
<td>65.5</td>
</tr>
<tr>
<td>No influence</td>
<td>11.5</td>
<td>25.4</td>
</tr>
<tr>
<td>Negative influence</td>
<td>4.0</td>
<td>9.1</td>
</tr>
<tr>
<td>No answer</td>
<td>17.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Survey of teachers

Up to 26 percent of teachers find no risks for students dealing with computers. More realistic teachers see the main risks of ICT use in education as follows:

- Negative information placed on Internet sites (42.3 percent of teachers of humanities)
- “Game mania or addiction” (28.6 percent of teachers of natural sciences)
- Excessive time spent with computer to the prejudice of studying (11.6 percent of teachers of humanities)

Table A2.7 Parents’ View of the Risks and Obstacles of ICT Use in Education (percentage)

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Urban (%)</th>
<th>Rural (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No risks</td>
<td>46.6</td>
<td>36.9</td>
</tr>
<tr>
<td>Possible dependence on computer</td>
<td>10.4</td>
<td>15.3</td>
</tr>
<tr>
<td>Threat to eye-sight</td>
<td>11.9</td>
<td>13.7</td>
</tr>
<tr>
<td>No coordination between school software and home PC</td>
<td>8.2</td>
<td>11.0</td>
</tr>
<tr>
<td>Lack of quality educational software</td>
<td>2.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Hypodinia (Low physical activity)</td>
<td>6.3</td>
<td>4.7</td>
</tr>
<tr>
<td>High Internet traffic</td>
<td>4.0</td>
<td>3.3</td>
</tr>
<tr>
<td>No answer</td>
<td>10.3</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Source: Survey of parents

Use of ICT in Education: Conclusions

Generally speaking there is both hardware and software available in educational institutions for the implementation and use of ICT. However, there is a demand for the development and implementation of locally made software that takes into consideration the specifics of the regional component of the general school curriculum, the requirements for entry of regional higher education institutions, and the specifics of vocational training.

The region has good capacity and the experience needed for the development of extra curricular education and of general education outside school walls. However financial support is needed for existing centers of excellence and dissemination of experience.
Distance Education

Some work on the adaptation and improvement of distance education technologies has been implemented in the region. Since 1999, the Regional Education Center has implemented a distance learning course in general education for small groups of students. In 2000 and 2001, 14 and 19 students in Irkutsk city got general education certificates. In 2001, also, 117 students in four regional towns took the same courses and got the certificates. The center uses Internet technologies for the exchange and shared use of educational information between students and tutors.

Box A2.5 A University Develops Electronic Distance Education

Baikal’s learning center at Irkutsk State University developed a program of distance education with opportunities for teachers to create original electronic learning courses, for administrators to manage the education process effectively, and for students to build individual learning plans.

In 2001, Irkutsk State University and Irkutsk State Technical University started to implement a cooperative project, the Irkutsk Virtual University, under the aegis of the Institute of Open Education of the Ministry of Education of Russia.

There are no distance education programs for initial vocational education.

Home Computers

Sociological research conducted as a part of our study gives data concerning the number of home computers in families of general school students in small towns and rural areas of the Irkutsk region, as well as a number for computers connected to the Internet (see table A2.8).

The case with students of the IVE system, however, is complicated by the scarcity of home computers among them. The surveyed municipal educational institutions included one rural vocational college. No student there has a home computer because of the low income level of parents and the absence of strong ICT demand. Therefore, an additional survey was carried out in two initial vocational schools (# 9 and # 13) in the small town of Cheremkhovo. There, too, no students have home computers.

Table A2.8 Number of Students’ Home Computers (percentage)

<table>
<thead>
<tr>
<th>Student</th>
<th>Have a computer at home (out of all students, %)</th>
<th>Have personal e-mail address (out of those students who have home computer, %)</th>
<th>Have Internet access at home (out of those students who have computer, %)</th>
<th>Have Internet access at home (out of all students, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-11th grades</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban area</td>
<td>7.5</td>
<td>11.3</td>
<td>41.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Rural area</td>
<td>5.3</td>
<td>2.1</td>
<td>8.2</td>
<td>0.4</td>
</tr>
<tr>
<td>1-7th grades</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban area</td>
<td>3.3</td>
<td>3.4</td>
<td>43.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Rural area</td>
<td>2.2</td>
<td>NA</td>
<td>21.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

NA - not available

Source: Survey of students

Out of the total number of urban students in grades 8 to11 having computers at home, 64 percent study in privileged schools (gymnasia and lyceums).

In urban areas, 47.4 percent of students with home computers use multimedia learning programs and 59 percent have reference materials and encyclopedias. In rural area this educational software is not that common (21.5 percent and 7.3 percent respectively) due to the undeveloped software market. The use of
software developed by schools is relatively low in rural schools: 3 percent, and reaches as much as 23 percent in urban schools. In urban areas, 32.1 percent of students and in rural areas, 24.6 percent of students (mostly male students of grades 10 and 11) occasionally spend their own incomes to purchase educational software. This fact demonstrates a positive attitude among students toward using ICT for educational purpose.

According to figure A2.5 more than a quarter of urban students in grades 8 to 11 and 38 percent of their rural coevals scarcely use home computers for educational purposes. This means that teachers do not require their students take advantage of the opportunity to use home computers for educational needs. At the same time, there is data showing that most informatics teachers do encourage students to use home computers for curricular and extracurricular activities, primarily for information search on the Internet. However, there is little evidence of such a practice among teachers of other subjects.

**Figure A2.5 Use of a Home Computer for Educational Purpose**

![Graph showing the use of home computers for educational purposes in urban and rural areas](https://example.com/graph)

Fewer than half of urban students who have a computer at home and slightly more than one third of students from rural areas are participating or planning to participate in telecommunication projects.

*Source: Survey of students*

**Conclusions Regarding Home Computers**

The social and economic status of most families of general and initial vocational school students is low. The number of families that can afford to use ICT at home is insignificant in small towns and close to the zero in rural community. The situation is better in big cities with comparatively well developed economies, which demonstrates growing digital divide issue. A rural school becomes the only place where students can get access to computers and acquire ICT skills.

**Human Resources**

This section examines teachers’ perception of their need for ICT training and the regional resources available.

**General Situation**

According to estimates by experts, about 80 percent of regional general and IVE teachers and administrators need training in the use of ICT. This means that about 80 percent of staff never (or not recently) had this sort of training. However, there has been no analysis of teachers’ real needs in ICT training and the possibilities for further practical use of received skills and knowledge. So far, all we have to go on are the teachers’ own opinions about what they need (see table A2.9). For example, only 28 percent of urban teachers of history and social science consider mastering the methodology of ICT use as a necessary skill. However, 58 percent of teachers of physics, mathematics, chemistry, biology, and geography have the same belief (see table A2.9 for more information).
Table A2.9 Teachers’ Attitudes Toward Mastering the Methodology of ICT Use for Educational Purposes (percentage)

<table>
<thead>
<tr>
<th>Teacher attitude</th>
<th>Urban (%)</th>
<th>Rural (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers of informatics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider mastering the methodology of ICT use as necessary skill</td>
<td>88</td>
<td>90</td>
</tr>
<tr>
<td>Experience demand only in general familiarization</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td><strong>Teachers of physics, mathematics, chemistry, biology, and geography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider mastering the methodology of ICT use as necessary skill</td>
<td>58</td>
<td>69</td>
</tr>
<tr>
<td>Experience demand only in general familiarization</td>
<td>39</td>
<td>27</td>
</tr>
<tr>
<td><strong>Teachers of history and social science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider mastering the methodology of ICT use as necessary skill</td>
<td>28</td>
<td>69</td>
</tr>
<tr>
<td>Experience demand only in general familiarization</td>
<td>59</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: Survey of teachers

Urban teachers have access to ICT in schools, in information centers, in centers for in-service training of teachers, and via dial-up connection and work in city communication centers. Access to ICT for rural teachers is limited to the school. Informatics teachers use ICT on a daily basis, whereas, half of all science, history, and social science teachers scarcely use ICT at all. Teachers of different subject areas estimate their ICT skills in the various ways shown in table A2.10).

Table A2.10 Level of ICT Skills of Teachers (teachers’ views in percentage)

<table>
<thead>
<tr>
<th>Level</th>
<th>Urban areas (%)</th>
<th>Rural areas (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers of informatics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced level</td>
<td>67</td>
<td>52</td>
</tr>
<tr>
<td>Have some difficulties</td>
<td>33</td>
<td>48</td>
</tr>
<tr>
<td><strong>Teachers of physics, mathematics, chemistry, biology, geography</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced level</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Have some difficulties</td>
<td>59</td>
<td>58</td>
</tr>
<tr>
<td><strong>Teachers of history and social science</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced level</td>
<td>77</td>
<td>42</td>
</tr>
<tr>
<td>Have some difficulties</td>
<td>20</td>
<td>38</td>
</tr>
</tbody>
</table>

Notes: * The sum of percentages can be less than 100 as some teachers did not answer the question.
Source: Survey of teachers and administrators

In-Service Training

The following organizations in the region provide in-service ICT training for teachers and administrators:

- Irkutsk In-Service Teacher Training Institute (and two district branches)
- Internet Center of Federation of Internet Education
- Russian-British Cultural and Educational Center
- Internet Center of Initial Vocational Education Lyceum # 17
- Regional Education Center
- Internet Center of Irkutsk State University
Since 1995, a chair of education informatization (the Russian term for the introduction of ICT in education) at the Irkutsk In-Service Teacher Training Institute (IISTTI) has run courses for the professional development of ICT teachers. Since 1998, it has used modern information and telecommunication technologies in providing this sort of training. In June 2001 the regional center of the Federation of Internet Education (FIE) was opened as a department of IISTTI. The center’s activities are aimed at training school teachers and administrators as tutors for introducing ICT in education. IISTTI computer capacities include the following: four classes equipped with ten computers each, a dedicated channel for Internet access, and a website of the center; it also has twenty workplaces in two classes, each of which has dial-up Internet access. The FIE center has the capacity to train 560 teachers per year. In addition, 50–60 teachers take part in a monthly ICT teacher training course, and recently a course “Use of ICT in Elementary School” was introduced for school teachers.

The Russian-British Cultural and Educational Center trains English language teachers in using Internet technologies.

The Initial Vocational Education Lyceum # 17 provides training courses for technical and pedagogical staff in the area of basic computer skills and the use of ICT in teaching practice.

Preservice Training Provision

The following organizations in the region provide preservice ICT training for teachers and administrators:

- Irkutsk State Pedagogical University
- Irkutsk State Linguistic University
- Ten pedagogical colleges

There is a system of training informatics teachers for every level of education. Irkutsk State Pedagogical University provides training for informatics teachers as well as ICT skills for teachers of physics and mathematics teachers for use in their teaching. The State Pedagogical University and the State Linguistic University have introduced a new course “ICT in Teaching a Specific Subject” as an addition to their traditional courses “The Basis of Computer Science and Information Technologies.”

All initial, secondary, and higher professional pedagogical educational institutions in the region are equipped with modern computer classes. Computers are used to monitor quality of knowledge and student performance, to teach subjects in the psychological and pedagogical sphere, to implement research activities. Students study a number of subjects requiring ICT skills, including “Informatics and Computer Engineering,” “Information Technologies,” etc.

Human Resources: Conclusions

The teacher training and retraining system is developed and includes private as well as state institutions. Future and existing teachers have a variety of opportunities to develop ICT skills and get trained in implementing modern teaching and learning approaches based on ICT. Although the existing capacity can not satisfy current demand for teacher training in educational use of ICT. However there is evidence that a more flexible approach to the content of training and post-training support is needed.
ICT PROGRAM IN EDUCATION

At the present stage of developments, the Irkutsk education administration highlights the following issues as being essential at the regional level:

- Creation of ICT resource centers in four main cities (Angarsk, Bratsk, Baykalsk, Ust-Orda) to draw educational institutions in remote areas further into the process of introducing ICT
- Large scale training of education managers and staff
- Connecting all district and municipal education administrations into a common network to create a regional system of education e-management
- Creating a system of distance education
- Developing software that can be used to explore new areas of knowledge and to support the building of individual learning trends
- Building a system for the regional vertical management of information resources and its coordination with various socially oriented projects
- Effective integration of regional and federal initiatives and resources to develop existing ICT capacity in the region.

The following are the main priorities of ICT programs at the school and municipal levels:

- Introduce ICT in teaching every school subject
- Introduce an ICT based system to assess students’ performance
- Introduce ICT in vocational training of high school students
- Develop a teaching approach using ICT and oriented to individual students
- Introduce an intersubject teaching and learning approach and build sustainable intersubject links by means of ICT.

Regional Program

As noted earlier, the regional program for introducing ICT into education is called Development of a Common Educational Information Space for Irkutsk Oblast for 2003–2005 (regional E-Education). It has three objectives, three main tasks, five main activities, and ten main outputs.

Objectives

The regional E-Education program is designed to form part of the common educational information space of Russia. Objectives are as follows:

- To provide the population of Irkutsk region with equal opportunities for receiving education on every level
- To provide quality general, professional, and extracurricular education relative to the demands of modern society through the methods of modern technologies
- To integrate electronic and traditional learning materials and introduce modern ICT in education.

Main Tasks

Main tasks for regional E-Education program are the following:
• To create conditions for disseminating modern electronic learning materials (ELM), and support and for introducing them into the learning process. Thereby, to provide a system of quality assurance, standards, and certification of educational ICT
• To train pedagogical, administrative, and technical staff to use modern ICT in the learning process of regional educational institutions
• To provide educational institutions in the region with computer techniques, electronic learning materials, and access to global informational resources.

Main Activities

Main activities for the regional E-Education program are the following:

• Creation of electronic learning materials and means of support for the learning process
• Retraining of pedagogical, administrative, and technical staff
• Providing educational institutions with computer techniques
• Creating a common educational information space
• Organization of service support for hardware of education institutions.

Main Outputs

Main projected outputs for the regional E-Education program are the following:

• Quality of education to be increased by the introduction of ICT into the learning process
• Educational institutions to be equipped with modern computer equipment and provided with access to global information resources
• Equal educational opportunities to be provided on every level from primary school to higher education
• Software, methodological support materials, and ELM to be developed to reflect advanced approaches in scientific and educational research and regionally specific needs
• Conditions to be created for developing interactive distance education through access to global information resources
• System to be created for methodological and technical support for teachers’ retraining
• Conditions to be created for the social adaptation of people with disabilities and to allow them to receive education
• System to be established for the selection of gifted children and the provision by leading teachers and scientists of education services for them based on ICT
• Educational database to be developed, including information on students’ performance in networked testing
• Centres of informational, education, scientific, and technical support of education and common educational information space to be created

The regional budget is the only source of financing the program. Total financing of the program is R166.85 million (US$5.6 million).

The Program as a Whole: Conclusions

The regional program is strongly based on the objectives, tasks, and timing of the federal E-Education program. At the same time, it accepts current ICT capacity of the region and reflects its specifics. However, the mechanism of cooperation, coordination of efforts, and sharing of responsibilities between federal and regional levels is the subject for further discussion.
The strong orientation of the regional *E-Education* program on the federal one often leads to the repetition of policy issues and weaknesses. Thus the regional program seems to be supply driven and has no clear qualitative indicators of success. Educational effects reached by introducing ICT into education are mentioned in the program (although not specified). There is no clear distinction in concrete activities to be implemented on regional and federal level. For instance the task of developing and producing of ELM is included in both regional and federal programs but the process of testing and piloting new ELM (which is the key step for successful embedding of ELM into teaching practice and is to be done on local level) is hardly mentioned in the regional program but appears in the federal one. Although the analysis and cataloguing of the best Russian and international ELM is the part of regional program, it is also, obviously, reasonable and cost effective to implement this job at the federal level. While, distance education system development is mentioned as one of the main issues at the stage, at the same time it is poorly addressed in the program.

Nevertheless, the regional program is closer to the ground and it addresses the issues that are well know by education authorities. A lot of work in the area of introducing ICT in education was done before 2002 and the program is intended to support and develop the existing capacity in this area.
Appendix 3

The Russian Education System

BASIC DATA

Table A3.1 Projection of Real GDP, Public Expenditure on Education, Number of Teachers, and Salary Expenditure Per Teacher, 2000 – 2005

<table>
<thead>
<tr>
<th>Projection</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at 2000 prices (bn rubles)</td>
<td>7,063</td>
<td>7,416</td>
<td>7,683</td>
<td>8,021</td>
<td>8,454</td>
<td>8,928</td>
</tr>
<tr>
<td>Growth rate (%)</td>
<td>5.0</td>
<td>3.6</td>
<td>4.4</td>
<td>5.4</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Public expenditure on education as % of GDP</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>3.9</td>
<td>4.2</td>
<td>4.5</td>
</tr>
<tr>
<td>Public expenditure on education at 2000 prices (bn rubles)</td>
<td>214.0</td>
<td>241.3</td>
<td>276.6</td>
<td>312.8</td>
<td>355.1</td>
<td>401.7</td>
</tr>
<tr>
<td>Salaries as % of educational expenditure</td>
<td>39.4</td>
<td>39.4</td>
<td>39.4</td>
<td>39.4</td>
<td>39.4</td>
<td>39.4</td>
</tr>
<tr>
<td>Number of teachers (mn)</td>
<td>3.64</td>
<td>3.64</td>
<td>3.64</td>
<td>3.64</td>
<td>3.64</td>
<td>3.64</td>
</tr>
<tr>
<td>Salary expenditure per teacher at 2000 prices ('000 rubles)</td>
<td>23.2</td>
<td>26.1</td>
<td>29.9</td>
<td>33.9</td>
<td>38.4</td>
<td>43.5</td>
</tr>
</tbody>
</table>

Sources: projected GDP growth rates – revised government targets, Moscow Times, May 16, 2002; public expenditure on education as percent of GDP – 2000 and 2001, IMF, projections – the State Council of the Russian Federation, Education Policy at the Contemporary Stage, 2001; salaries as percent of educational expenditure – Canning et al. (1999: Table Annex G4); number of teachers – calculated from UNICEF MONEE database.

Table A3.2 Trends in Enrollment in Russian Private Schools, by Level, and in Grammar Schools and Lycea, 1993–2001 ('000)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Private:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preschools</td>
<td>638</td>
<td>307</td>
<td>381</td>
<td>322</td>
<td>247</td>
<td>205</td>
<td>173</td>
<td>160</td>
<td>144</td>
</tr>
<tr>
<td>Primary</td>
<td>17</td>
<td>20</td>
<td>23</td>
<td>21</td>
<td>20</td>
<td>18</td>
<td>18</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Lower 2ndary</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>19</td>
<td>22</td>
<td>23</td>
<td>25</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>Upper 2ndary</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Nonuniversity tertiary</td>
<td>7</td>
<td>11</td>
<td>16</td>
<td>17</td>
<td>28</td>
<td>28</td>
<td>52</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>69</td>
<td>111</td>
<td>135</td>
<td>163</td>
<td>202</td>
<td>251</td>
<td>345</td>
<td>471</td>
<td>630</td>
</tr>
<tr>
<td>Grammar schools</td>
<td>433</td>
<td>553</td>
<td>641</td>
<td>715</td>
<td>793</td>
<td>847</td>
<td>840</td>
<td>870</td>
<td>877</td>
</tr>
<tr>
<td>Lyceum</td>
<td>215</td>
<td>284</td>
<td>332</td>
<td>373</td>
<td>426</td>
<td>472</td>
<td>493</td>
<td>519</td>
<td>521</td>
</tr>
</tbody>
</table>

Table A3.3  Number of General Schools (Without Specialized Schools) and General School Students

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total number of schools</td>
<td>19,328</td>
<td>19,346</td>
<td>19,422</td>
<td>45,065</td>
<td>44,565</td>
<td>44,248</td>
<td>64,393</td>
<td>63,911</td>
<td>63,670</td>
</tr>
<tr>
<td>including:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gymnasia</td>
<td>962</td>
<td>1,011</td>
<td>1,055</td>
<td>65</td>
<td>67</td>
<td>70</td>
<td>1,027</td>
<td>1,078</td>
<td>1,125</td>
</tr>
<tr>
<td>lyceum</td>
<td>641</td>
<td>688</td>
<td>706</td>
<td>58</td>
<td>62</td>
<td>63</td>
<td>699</td>
<td>750</td>
<td>769</td>
</tr>
<tr>
<td>Total number of students</td>
<td>13,981,634</td>
<td>13,407,220</td>
<td>12,908,794</td>
<td>6,133,425</td>
<td>5,903,270</td>
<td>5,780,083</td>
<td>20,115,059</td>
<td>19,310,490</td>
<td>18,688,877</td>
</tr>
<tr>
<td>including:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in gymnasia</td>
<td>792,979</td>
<td>825,826</td>
<td>836,032</td>
<td>28,891</td>
<td>32,040</td>
<td>30,216</td>
<td>821,870</td>
<td>857,866</td>
<td>866,248</td>
</tr>
<tr>
<td>in lyceum</td>
<td>458,327</td>
<td>485,921</td>
<td>490,274</td>
<td>18,705</td>
<td>20,188</td>
<td>20,867</td>
<td>477,032</td>
<td>506,109</td>
<td>511,141</td>
</tr>
</tbody>
</table>


Table A3.4  Information about General Schools Teachers

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of teachers</td>
<td>910,049</td>
<td>880,070</td>
<td>645,909</td>
<td>638,319</td>
<td>1,555,958</td>
<td>1,518,389</td>
<td>1,555,958</td>
<td>1,518,389</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Including women</td>
<td>810,765</td>
<td>788,066</td>
<td>517,197</td>
<td>514,777</td>
<td>1,327,962</td>
<td>1,302,843</td>
<td>1,327,962</td>
<td>1,302,843</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Including teachers of pension age</td>
<td>115,643</td>
<td>111,269</td>
<td>50,090</td>
<td>47,938</td>
<td>165,733</td>
<td>159,207</td>
<td>165,733</td>
<td>159,207</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Including teachers with length of service:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than 20 years</td>
<td>325</td>
<td>325,396</td>
<td>222,174</td>
<td>227,239</td>
<td>547,338</td>
<td>552,635</td>
<td>547,338</td>
<td>552,635</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table A3.5  Selective Data on Financing Education in Russia, 2001

<table>
<thead>
<tr>
<th>Incomes and Expenditures</th>
<th>R’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomes of the federal budget</td>
<td>1,272,012,258</td>
</tr>
<tr>
<td>Expenditures of the federal budget</td>
<td>1,270,345,901</td>
</tr>
<tr>
<td>Deficiency (proficiency) of the federal budget</td>
<td>1,666,357</td>
</tr>
<tr>
<td>Expenditures for education in total</td>
<td>221,726,874</td>
</tr>
<tr>
<td>including:</td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>88,427,437</td>
</tr>
<tr>
<td>Medicine</td>
<td>187,722</td>
</tr>
<tr>
<td>Meals</td>
<td>13,972,969</td>
</tr>
<tr>
<td>Investments in capital assets</td>
<td>4,640,822</td>
</tr>
<tr>
<td>Capital construction</td>
<td>7,475,950</td>
</tr>
<tr>
<td>Share of expenditures for education in the total expenditures of the federal budget</td>
<td>17.5</td>
</tr>
</tbody>
</table>

### Table A3.6  Selected Data on Financing the Education System in Russia for 1997–2001

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total state expenditures for education (million rub)</td>
<td>108,852</td>
<td>97,024</td>
<td>147,017</td>
<td>211,438</td>
<td>na</td>
</tr>
<tr>
<td>Share of expenditures for education in GDP (%)</td>
<td>4.88</td>
<td>4.00</td>
<td>3.54</td>
<td>3.37</td>
<td>na</td>
</tr>
<tr>
<td>Share of expenditures for education in consolidated budget (%)</td>
<td>12.7</td>
<td>12.2</td>
<td>11.2</td>
<td>10.5</td>
<td>na</td>
</tr>
<tr>
<td>Share of expenditures for education in the federal budget (%)</td>
<td>3.5</td>
<td>3.3</td>
<td>3.2</td>
<td>3.7</td>
<td>na</td>
</tr>
<tr>
<td>Share of expenditures for education in regional budgets (%)</td>
<td>21.1</td>
<td>20.7</td>
<td>19.4</td>
<td>17.4</td>
<td>17.5</td>
</tr>
<tr>
<td>Average wage in education sector</td>
<td>616.2</td>
<td>660.5</td>
<td>885</td>
<td>1,234.6</td>
<td>1,814.8</td>
</tr>
<tr>
<td>Rate of average wage in Education sector compared to average wage in economy</td>
<td>0.65</td>
<td>0.63</td>
<td>0.58</td>
<td>0.56</td>
<td>0.55</td>
</tr>
<tr>
<td>Establishment of new general education institutions (thousands of students)</td>
<td>155</td>
<td>123</td>
<td>109</td>
<td>134</td>
<td>117</td>
</tr>
<tr>
<td>Establishment of new IVE institutions (thousands of students)</td>
<td>2</td>
<td>1.3</td>
<td>1.8</td>
<td>0.6</td>
<td>na</td>
</tr>
<tr>
<td>Establishment of new SVE institutions (thousands of square meters)</td>
<td>16.2</td>
<td>20.9</td>
<td>8.3</td>
<td>18.2</td>
<td>na</td>
</tr>
<tr>
<td>Establishment of new HE institutions (thousand of square meters)</td>
<td>81.7</td>
<td>42.3</td>
<td>110.1</td>
<td>105.6</td>
<td>na</td>
</tr>
</tbody>
</table>

*na = not available


The data on wages, on education objects construction are taken from "the Russian statistical year-book 2001" Goskomstat of Russia, p.187, 188, 443

### Table A3.7  Information about Initial Vocational Institutions in Russia, 1985–2000

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of initial vocational institutions</td>
<td>4,196</td>
<td>4,328</td>
<td>4,166</td>
<td>4,050</td>
<td>3,954</td>
<td>3,911</td>
<td>3,893</td>
</tr>
<tr>
<td>Total number of students entering initial vocational institutions (thousand)</td>
<td>1,527</td>
<td>1,266</td>
<td>1,120</td>
<td>1,106</td>
<td>1,158</td>
<td>1,195</td>
<td>1,213</td>
</tr>
</tbody>
</table>


In 2000 about 24 percent of initial vocational institutions were advanced IVE schools (vocational lycceum).

### Table A3.8  Information about Staff of Initial Vocational Institutions in Russia, 2000

<table>
<thead>
<tr>
<th>Staff</th>
<th>Total number of staff</th>
<th>Including staff with higher education diploma</th>
<th>vocational education diploma</th>
<th>general education diploma</th>
<th>Including women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of pedagogical, management, and technical staff</td>
<td>157,114</td>
<td>89,192</td>
<td>55,313</td>
<td>12,609</td>
<td>96,402</td>
</tr>
<tr>
<td>percent from total number of technical staff</td>
<td>56.8</td>
<td>35.2</td>
<td>8.0</td>
<td>61.4</td>
<td></td>
</tr>
</tbody>
</table>

COMPARATIVE PERSPECTIVES

Figure A3.1 Trends in Population of Basic School-Age Children, Russia Compared With Europe And Central Asia Sub-Regions, 1989–2001

Source: UNICEF MONEE project database.

Figure A3.2 Basic Education Enrolment Rates: Russia Compared with Europe and Central Asia Sub-Regions, 1989–2000 (Percentage)

Note: Rates are gross and unweighted.
Source: TransMONEE database.
Figure A3.3 Vocational/Technical School Enrolment Rates, Russia Compared with Europe and Central Asia Sub-Regions, 1989–2000

Note: Rates are gross and weighted.
Source: MONEE project database.

Figure A3.4 Secondary General Education Enrolment Rates, Russia Compared with Europe and Central Asia Sub-Regions, 1989–2000 (Percentage)

Note: Rates are gross and unweighted.
Source: TransMONEE database.
Figure A3.5  Tertiary Enrolment Rates, Russia Compared with Europe and Central Asia Sub-Regions, 1989–2000 (percentage)

Note: Rates are gross and weighted.
Source: MONEE project database.

Figure A3.6  Trends in 8th Grade Mathematics Achievement, Russia Compared with Other Countries in The TIMSS Samples, 1995–1999

Source: UNICEF, based on data from Mullis et al. (2000: Exhibits 1.6 and 1.9).
Figure A3.7  Mean Scores For Student Performance on the Combined PISA Reading, Scientific and Mathematical Literacy Scales, Russia Compared with Four Other Transition Countries And 20 High-Hd Countries, 2000

Source: UNICEF (2002), based on data from OECD (2001:Table 3.6).

Figure A3.8  Indices of Students’ Learning Strategies (Memorization, Elaboration, Cooperative and Competitive), Russia and Other Transition Countries Compared with OECD Average, 2000

Note: Indices measure the extent to which student responses differ from the OECD mean (standardized at zero with standard deviation = one).
Source: OECD (2001:Tables 4.6, 4.7, 4.8 and 4.9).
In 2001, 37.2 percent of teachers consider their material status as insufficient against 15.9 percent in 1991, and as middle class – 8.6 percent in 2001 against 47.1 percent in 1991 (Sobkin, Rav1uk 2002). According to Goskomstat data for 2001, salaries of the absolute majority of teachers do not reach subsistence level.

### Table A3.9 Ranking by Microeconomic Competitiveness and Growth Competitiveness, Selected Transition Countries, 2002

<table>
<thead>
<tr>
<th></th>
<th>Microeconomic competitiveness</th>
<th>Growth competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovenia</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>Hungary</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Estonia</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>China</td>
<td>38</td>
<td>33</td>
</tr>
<tr>
<td>Lithuania</td>
<td>40</td>
<td>36</td>
</tr>
<tr>
<td>Slovakia</td>
<td>42</td>
<td>49</td>
</tr>
<tr>
<td>Latvia</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Poland</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td>Croatia</td>
<td>52</td>
<td>58</td>
</tr>
<tr>
<td>Russia</td>
<td>58</td>
<td>64</td>
</tr>
<tr>
<td>Vietnam</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Romania</td>
<td>67</td>
<td>66</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>68</td>
<td>62</td>
</tr>
<tr>
<td>Ukraine</td>
<td>69</td>
<td>77</td>
</tr>
</tbody>
</table>

### Table A3.10  Average Wage by Level of Education, Russia, 2000

<table>
<thead>
<tr>
<th>Education level</th>
<th>Average wage per month (Rb.)</th>
<th>Ratio (Elementary = 1.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>1,248</td>
<td>1.00</td>
</tr>
<tr>
<td>Secondary basic</td>
<td>1,603</td>
<td>1.28</td>
</tr>
<tr>
<td>Vocational</td>
<td>1,685</td>
<td>1.35</td>
</tr>
<tr>
<td>Secondary professional</td>
<td>1,591</td>
<td>1.27</td>
</tr>
<tr>
<td>University</td>
<td>2,320</td>
<td>1.86</td>
</tr>
</tbody>
</table>

Source: World Bank (2002:Table II.2)

### Table A3.11  Average Annual Software Labor Cost Comparison, 1999 (US$'000)

<table>
<thead>
<tr>
<th>Profession</th>
<th>Switzerland</th>
<th>USA</th>
<th>Canada</th>
<th>UK</th>
<th>Ireland</th>
<th>Greece</th>
<th>India</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project leader</td>
<td>90.0</td>
<td>65.6</td>
<td>47.4</td>
<td>47.4</td>
<td>52.3</td>
<td>35.1</td>
<td>33.7</td>
<td>34.4</td>
</tr>
<tr>
<td>Business analyst</td>
<td>89.9</td>
<td>46.0</td>
<td>43.8</td>
<td>45.0</td>
<td>43.8</td>
<td>41.0</td>
<td>31.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Systems analyst</td>
<td>89.9</td>
<td>58.3</td>
<td>39.0</td>
<td>41.3</td>
<td>43.8</td>
<td>22.0</td>
<td>20.5</td>
<td>36.4</td>
</tr>
<tr>
<td>Systems designer</td>
<td>81.4</td>
<td>66.9</td>
<td>43.8</td>
<td>41.3</td>
<td>37.7</td>
<td>22.0</td>
<td>16.1</td>
<td>25.1</td>
</tr>
<tr>
<td>Development programmer</td>
<td>68.0</td>
<td>49.8</td>
<td>35.3</td>
<td>35.3</td>
<td>25.6</td>
<td>19.0</td>
<td>11.7</td>
<td>31.7</td>
</tr>
<tr>
<td>Support programmer</td>
<td>68.0</td>
<td>45.0</td>
<td>31.6</td>
<td>30.4</td>
<td>25.6</td>
<td>22.0</td>
<td>11.7</td>
<td>18.7</td>
</tr>
<tr>
<td>Network analyst/ designer</td>
<td>81.4</td>
<td>59.6</td>
<td>39.0</td>
<td>38.0</td>
<td>31.6</td>
<td>22.0</td>
<td>20.5</td>
<td>26.6</td>
</tr>
<tr>
<td>Quality assurance specialist</td>
<td>86.3</td>
<td>60.8</td>
<td>34.0</td>
<td>40.1</td>
<td>35.3</td>
<td>22.0</td>
<td>20.5</td>
<td>...</td>
</tr>
<tr>
<td>Database data analyst</td>
<td>81.4</td>
<td>60.8</td>
<td>39.0</td>
<td>26.7</td>
<td>35.3</td>
<td>35.1</td>
<td>24.9</td>
<td>26.4</td>
</tr>
<tr>
<td>Metrics/ process analyst</td>
<td>89.9</td>
<td>58.3</td>
<td>35.3</td>
<td>37.7</td>
<td>...</td>
<td>22.0</td>
<td>24.9</td>
<td>...</td>
</tr>
<tr>
<td>Documentation/ training staff</td>
<td>71.7</td>
<td>43.8</td>
<td>31.6</td>
<td>25.6</td>
<td>...</td>
<td>22.0</td>
<td>11.7</td>
<td>...</td>
</tr>
<tr>
<td>Test engineer</td>
<td>71.7</td>
<td>57.1</td>
<td>30.4</td>
<td>29.2</td>
<td>...</td>
<td>19.0</td>
<td>11.7</td>
<td>...</td>
</tr>
</tbody>
</table>

... not available.

Source: ILO (2001: Table 4.6).
Appendix 4

E-Learning and Distance Education in Russia

EXISTING COMMUNICATION INFRASTRUCTURE AND HARDWARE RESOURCES

The potential for using existing communication infrastructure for electronic teaching and learning in Russia varies with the resources of different parts of the region.

Telephone Infrastructure

In big cities and selected towns (including those along the railways) telephone infrastructure is quite developed; there the possibility for competition among the main owners of the channels can lead to a decreasing cost of renting the channels for education purposes.

However the communication lines in rural and remote areas are very weak. Some northern and remote cities are connected with main networks through satellite but there is no economic interest for private companies to develop this infrastructure further to small towns and villages. In some rural areas the phone lines are so outdated that they do not allow an automatic connection. About 40 percent of villages do not have phone communications at all (Russia E-readiness and e-needs assessment, 2001).

Overall penetration of telephone infrastructure is 21.3 per 100 of population for fixed lines. Only 6 percent of Russians live in the largest city and percent of all fixed phones in the largest city is 13 percent of all fixed phones. So it is probable that the five largest cities could account for 30 percent of all fixed phones. Consequently, the penetration rate in the next 10 largest cities is well below the average of 22 per 100 of population. And as we progressively go down the list of large cities and towns the penetration rate will fall dramatically. In rural areas capital investments for phone lines building are 5 times higher than in urban areas (Russia E-readiness and e-needs assessment, 2001).

Muscovites fared better than the rest of the country, with 91 percent of the capital's residents having telephones at home and 28.6 percent carrying cell phones. Only 2.9 percent of the rural population has cell phones. Some 9 percent of Russians has a cell phone. Cell phone use, however, has risen dramatically since last year, when only 4 percent of the population owned a handset, according to Russian Center for Public Opinion Survey (VTsIOM).

Even in big cities the “last mile problems” is not solved for the schools. They often have only one telephone line. The average cost for building an additional phone line to provide dedicated phone line or dial-up connection is $500 and $15 per month for using the line. There are almost no examples where a school has a dedicated high-speed channel for getting access to Internet.

Internet Services

Only 8 percent of Russians have ever surfed the Internet. Only 3.6 percent of those use the Internet frequently, with people aged 25 to 34 the most active at 7.5 percent followed by the 16-to-24 age group at 7.3 percent. Less than 1 percent of the rural population are frequent Internet users.  

1 The Moscow Times, October 10, 2002
One of the most serious constraints for Internet services dissemination is the persistent high cost. According to the Russia E-readiness and e-needs assessment (2001) the average potential user is ready to pay up to $15 per month when the minimum cost of Internet service providers (ISP) is $30. Obviously this cost is not affordable for teachers and families with low income. The cost of unlimited Internet connection by a dedicated high-speed channel is about $500 per month which is very high for the average school.

According to the findings of the survey *Russia in the Internet* made by the Public Opinion Foundation (unpublished, 2002: <www.strana.ru>), people with a per family member income above US$100 account for 29 percent of proactive network users while that number amounts to only 15 percent with regard to the people of low activity. It should be noted that an average proportion of people with a similar income accounts for four percent in the country. As a result, growth in the Internet key audience is not a significant resource today. The data produced by monitoring.ru also confirm that people with a high income level more frequently form a proactive part of the audience.

HEIs receive significant support for their Internet services through government-supported noncommercial Internet service providers (ISPs) (some of them even own telecommunication channels). About 50 percent of students in selected leading HEIs reported that they use Internet in their universities. Schools and IVE institutions do not have these opportunities as a rule.

There are some initiatives in providing general schools with so-called asymmetric Internet through a satellite. About 4,000 satellite dishes will be installed in rural general schools by the end of 2002.

Home Internet use is becoming a significant factor. By the end of 2000 about one third of all home computers in big cities were connected to the Internet (Russia E-readiness and e-needs assessment, 2001).

Of all education institutions, 29.5 percent are using local area networks (LAN) and 33.5 percent of computers in education institutions are incorporated into LANs.

**Box A4.1 An Example – A Telecommunication Net in Action**

An educational telecommunication net called TIT-BIT has been functioning in Yaroslavl oblast since 1993. It has over 120 subscribers (regional department of education, schools). At the first stage, the network supported only the school administration system, but since 1995, it has been used for providing methodological assistance to general subject teachers. Local TV conferences arouse the utmost interest. The server is open for:

- Teachers of Russian and literature,
- First generation computers users,
- Issues of primary school studies,
- Information technologies in education.

Network technology studies were compulsory in all courses. For this purpose educational and methodological materials, Telecommunications in Education (12 hours) were produced.

**Availability of ICT Resources in Educational Institutions**
Table A4.1 Technical Set-Up of General Schools in Russia

<table>
<thead>
<tr>
<th>Share</th>
<th>Urban area</th>
<th>Rural area</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of schools equipped with Informatics classrooms</td>
<td>67</td>
<td>69</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>Percentage of schools requiring major overhaul</td>
<td>5</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Percentage of schools in accident condition</td>
<td>89</td>
<td>89</td>
<td>33</td>
</tr>
</tbody>
</table>


ICT Within Extracurricular Education System

The total number of extracurricular education institutions is 8,699 with number of students 7,905,820. Many of these institutions provide training courses in ICT.

Table A4.2. Comparative Data on Introduction of ICT into General Education, Russia and Other Countries, 2000

<table>
<thead>
<tr>
<th>Well developed countries</th>
<th>Percentage of computers connected to the Internet/World Wide Web</th>
<th>Percentage of computers connected to a local area network</th>
<th>Students per computer ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>80</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>Austria</td>
<td>69</td>
<td>56</td>
<td>7</td>
</tr>
<tr>
<td>Belgium</td>
<td>45</td>
<td>33</td>
<td>11</td>
</tr>
<tr>
<td>Canada</td>
<td>80</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>Denmark</td>
<td>65</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Finland</td>
<td>84</td>
<td>57</td>
<td>8</td>
</tr>
<tr>
<td>France</td>
<td>26</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Germany</td>
<td>37</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Greece</td>
<td>26</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Iceland</td>
<td>83</td>
<td>62</td>
<td>10</td>
</tr>
<tr>
<td>Ireland</td>
<td>47</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>Italy</td>
<td>24</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>Japan</td>
<td>35</td>
<td>40</td>
<td>12</td>
</tr>
<tr>
<td>Korea</td>
<td>61</td>
<td>70</td>
<td>9</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>88</td>
<td>86</td>
<td>9</td>
</tr>
<tr>
<td>New Zealand</td>
<td>62</td>
<td>65</td>
<td>6</td>
</tr>
<tr>
<td>Norway</td>
<td>50</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>Portugal</td>
<td>35</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>Spain</td>
<td>41</td>
<td>37</td>
<td>21</td>
</tr>
</tbody>
</table>

103
<table>
<thead>
<tr>
<th>Country</th>
<th>1997</th>
<th>2000</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>74</td>
<td>62</td>
<td>8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>47</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>51</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td>United States</td>
<td>39</td>
<td>61</td>
<td>5</td>
</tr>
<tr>
<td><strong>OECD country mean</strong></td>
<td><strong>52</strong></td>
<td><strong>46</strong></td>
<td><strong>13</strong></td>
</tr>
<tr>
<td><strong>Transition and developing countries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>27</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Hungary</td>
<td>58</td>
<td>65</td>
<td>9</td>
</tr>
<tr>
<td>Mexico</td>
<td>14</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Poland</td>
<td>35</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>40</td>
<td>46</td>
<td>15</td>
</tr>
<tr>
<td>Latvia</td>
<td>42</td>
<td>57</td>
<td>5</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>79</td>
<td>67</td>
<td>57</td>
</tr>
<tr>
<td><strong>Russian Federation</strong></td>
<td><strong>6</strong></td>
<td><strong>18</strong></td>
<td><strong>113</strong>*</td>
</tr>
</tbody>
</table>

Note: * - calculated data for 2002.

Sources: Education at a glance. OECD Indicators 2002.

Student-per-computer ratio in Russia in 2002 was 113; meanwhile according to UNESCO data (Key indicators of ICT use in general education in CIS and Baltic countries. IITE), in 2000, there were 62 students per computer in Kazakhstan; 15 in Czech Republic; and 9 in Hungary.

However the number of computers per school does not reflect the use of ICT by students. More than 60 percent of students in big cities do not consider schools as a primary place for use of ICT. They use computers in homes, in clubs, in their parents’ working places.

**ICT EQUIPMENT USE**

**Household Computer Use**

In 1997, the average number of computers per 1,000 inhabitants in 9 post soviet countries was 53 while in Russia – 32 (data by UNESCO).

There were 43 computers per 1,000 people in Russia in 2000 (World Bank statistics). Russia ranked below Belize with 12.5 percent computer penetration, Bulgaria with 4.4 percent, Fiji with 5.5 percent, Jamaica with 4.7 percent and St. Vincent and the Grenadines with 10.6 percent computer penetration. In the United States, in contrast, there were 585 computers per 1,000 people in 2000.²

Only 17 percent of Russians have used a computer. The VTsIOM survey (2002) revealed that 11 percent of the population used a computer frequently, or once a day or several days a week. Some 25 percent of Muscovites used a computer frequently, compared with only 3 percent in rural areas. The 16-to-24 age group is the most active, 20 percent using computers frequently compared with 0.4 percent of those older than 65.³

² The Moscow Times, October 10, 2002
³ The Moscow Times, October 10, 2002
Only 7.2 percent of Russian households have computers at home, up from 5 percent in last year’s survey. The highest penetration was in Moscow, where 27.5 percent of the households has computers at home, compared with 2 percent of the rural population.4

**Student Computer Use**

The share of teenagers using computers regularly (i.e., almost every day) amounts to 38.1 percent. The share of those who use computers periodically is 21.8 percent. About 10.6% of teenagers use computers occasionally (once or twice a month), and about one third (29.6 percent) do not use them at all. At the same time it is noteworthy that the share of regular computer users among boys is twice as high as among girls – 53.7 percent and 23.5 percent, respectively. The share of those who prefer spending time at the computer in their free time is noticeably higher among boys than among girls (56.2 percent and 22.9 percent, respectively). Of students in high school, 56 percent use computers about 3.2 hours a day (average figure is 1.2 hours a day).

Results of sociological study (Social Assessment of e-Learning Support Project, 2002, The World Bank, Moscow, unpublished) show that entertainment is the dominant reason for computer use among teenagers; cognitive motivation is far less common: whereas 52.7 percent use computers for entertainment, a far smaller number – 22.2% say they “want to obtain new knowledge, information.” Even fewer respondents – 6.5 percent – mention direct motives related to education. For the rest, 10.2 percent claim to use computers for emotional relaxation and 9.1 percent to escape from reality. Such views should be taken into consideration when working on the integration of ICT into education (informatization); they show not only multiple motivations for computer use among students but the comparatively small proportion for whom the motivation is education. Moreover, the poor organization of modern teenagers’ leisure time should be noted: every second respondent says that he has nothing to do with his free time (49.2 percent).

Results of the opinion poll also demonstrate the effect of age on changes in motivation for computer use. Thus between grades 7 and 11, the number of students mentioning cognitive, informational, and direct educational motivation is increasing (from 19.7 percent to 27.4 percent for information, and from 5.1 percent to 9.4 percent for education). These changes indicate that the project should study the effect of age on student receptivity to the integration of ICT into education.

Results of the opinion poll among school students show no correlation between chronic diseases and regular computer use. Nevertheless, there are some negative symptoms (headaches, drowsiness, etc) associated with regular computer use. Thus, for instance, boys who use computers regularly mention headaches more often than boys of their age who do not use computers regularly (23.7 percent and 15.3 percent, respectively). This difference is very noticeable, especially in respect of such conditions as weakness and drowsiness. Regular computer users point them out twice as often as nonregular users (40.7 percent and 21.4 percent, respectively). And finally every fourth regular computer user (28.7 percent) mentioned his psychological dependence on computers. The same tendencies can be observed in Internet users.

Now, 79 percent of HEI students (and 88 percent of HEI teachers) use a computer at least once a week; 48.6 percent of HEI students (and 57.5 percent of HEI teachers) use computer at home; 40.5 percent and 82.3 percent - at work; 40.5 percent and 9 percent in HEI.

---

4 The Moscow Times, October 10, 2002
Teacher Computer Use

Less than 10 percent of Russian general school teachers were ever trained in educational use of ICT. At the same time in Kazakhstan and Uzbekistan the level of computer literacy among teachers is more than 80 percent (Key indicators of ICT use in general education in CIS and Baltic countries. IITE). In average, 71 percent of teachers in European Union regularly use computer in teaching (Basic indicators to the incorporation of ICT into European education systems, 2001).

Tables A4.3, A4.4, and A4.5 examine the degree to which teachers make use of computers both at home and at school.

Table A4.3  Share of Teachers Using Computers at Off-Hour Time in Different Age Groups, 2002 (percentage)

<table>
<thead>
<tr>
<th>Age</th>
<th>Average percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 years and younger</td>
<td>70.0</td>
</tr>
<tr>
<td>21-26 years</td>
<td>54.9</td>
</tr>
<tr>
<td>27-35 years</td>
<td>40.5</td>
</tr>
<tr>
<td>36-45 years</td>
<td>39.2</td>
</tr>
<tr>
<td>46-55 years</td>
<td>26.5</td>
</tr>
<tr>
<td>55 years and older</td>
<td>12.0</td>
</tr>
</tbody>
</table>


Table A4.4  Share of Teachers of Different Subjects Using Computers at Off-Hour Time, 2002 (percentage)

<table>
<thead>
<tr>
<th>Subject teachers</th>
<th>Average from the amount of teachers of each subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics</td>
<td>92.0</td>
</tr>
<tr>
<td>Drawing</td>
<td>52.9</td>
</tr>
<tr>
<td>Physics</td>
<td>41.7</td>
</tr>
<tr>
<td>Biology</td>
<td>41.7</td>
</tr>
<tr>
<td>History, Social sciences</td>
<td>41.5</td>
</tr>
<tr>
<td>Mathematics</td>
<td>39.3</td>
</tr>
<tr>
<td>Music</td>
<td>39.1</td>
</tr>
<tr>
<td>Chemistry</td>
<td>32.0</td>
</tr>
<tr>
<td>Physical education</td>
<td>28.0</td>
</tr>
<tr>
<td>Foreign languages</td>
<td>26.2</td>
</tr>
<tr>
<td>Geography</td>
<td>25.0</td>
</tr>
<tr>
<td>Handicraft lessons</td>
<td>25.0</td>
</tr>
<tr>
<td>Primary school subjects</td>
<td>24.3</td>
</tr>
<tr>
<td>Russian language, Literature</td>
<td>8.9</td>
</tr>
</tbody>
</table>


Table A4.5  Use of Educational and Demonstrational Computer Programs Among Teachers of Different Subjects (percentage)

<table>
<thead>
<tr>
<th>Subject teachers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics</td>
<td>79.2</td>
</tr>
<tr>
<td>Chemistry</td>
<td>28.9</td>
</tr>
<tr>
<td>Biology</td>
<td>26.3</td>
</tr>
</tbody>
</table>
RESOURCES FOR E-LEARNING AND DISTANCE EDUCATION

Russia has been late starting on the development of software for e-learning in schools.

E-Learning Material Production Capacity

The general situation with software and e-learning materials in Russian general and initial vocational education is always described as unsatisfactory (Russia E-readiness and e-needs assessment, 2001).

HEIs are active in the development of e-learning materials for higher education. According to estimates by the Ministry of Education, the number of e-learning materials developed by higher education institutions from 1998 and by March of 2001 was 14,000 titles. However, more than 50 percent of these materials are digitalized texts of lectures, strictly specialized methodological materials, exam questions, etc. Only 14 percent of the materials developed are available through networks.

The first attempts to start development of these materials are as late as the end of the nineteen-eighties. Today, there are about thirty big companies producing education software in Russia. Most of them are situated in Moscow. About five of them have distribution systems in Moscow and in regions, which is a great advantage in current market conditions. About eight regional higher education institutions have good capacity for developing educational electronic learning materials of good quality, although their financial situation does not allow for their wide production. It is almost impossible to estimate the Russian market for education software because of computer “pirates” and the absence of reliable statistics. Estimation by Russian experts is one million educational CDs for a year while the market is growing by 100 percent a year.

Box A4.2 A Software Company Produces Education Software for Home Use

In 1995 a computer trading company decided to produce a multimedia encyclopedia and distribute it as free complimentary software for computers it sells. Suddenly it realized that this sort of products has their own market and “Kirill and Mefodii” (K&M) was created to occupy some share of the market. Nowadays the company produces encyclopedias and reference e-books, business, finances and foreign languages related products, development programs for adults and children, art and culture materials, dictionaries, electronic training programs, multimedia textbooks for general school, etc. About 2 million of CD are produced per year and 3/4 of them have educational character. Two years ago the company reached profit point. From the very beginning “K&M” was focused on individual demand for educational CDs and produced programs for home use. Today, with a growth of school computer number K&M starts to move towards production of programs for use in school classrooms. So a teacher works directly (operates) with a program and a student gets “ready to use” information prepared by teacher. Although the company does not have stable partners in professional education society and does not set any rich of content targets.
K&M provides free lifelong technical support for all its multimedia products. All copyrights for e-program components (photos, texts) are bought from their authors and reserved. Cost of education e-products of K&M is commercial information but according to some estimation this cost is about several hundred thousand of dollars for encyclopedias production and several thousand of dollars for foreign languages e-textbook.

K&M started to develop a medium that gives an opportunity for a teacher to fulfill it with a proper content and design an original electronic learning material that suits concrete course purposes. The company is developing a media library (collection of multimedia resources) that gives a support in putting proper educational content into different e-based courses. A promising initiative is a development of educational courses that consist of two components: multimedia disc and normal textbook edition. These two components have special functions and together will provide advantages of traditional textbook (for instance, while reading extended texts) and multimedia textbook (for instance, for running some experiments, or reading interactive texts). One of advantages of such a system is additional protection from “pirates” as print textbook is not easy to produce and duplicate.

CD “pirates” are serious problem for the company. It loses substantial amounts of money because of intellectual property abuse; pirates CD costs 3-10 times less a licensed one. According to Datamonitor agency because computer pirates Russia lost $731 million of tax incomes in 2000 and Business Software Alliance estimates same lost by 2004 in $1.5 billion. K&M does not have wide network of distributors and regional distribution is not organized properly but regions do need that sort of products and information about brand new developments. Another problem is that the company can not affect price policy of retailers. There is a situation then a reseller’s rate of profit is too high which slows down product turnover pace a lot.

The system of getting licenses for electronic learning materials is completely nontransparent and the company faces corruption and arbitrariness in this field. K&M attracts education specialists from higher education institutions and Russian Academy of Science and there are experienced experts among them which gives positive effects long side with negative – in learning materials of new generation (multimedia textbooks) the old fashion approach to presenting material is used and new innovative experience is often ignored. Some programs have a character of digitalized traditional textbooks. All the products go through independent expertise although one can find some serious mistakes in content of some products.

E-Learning Materials For School Use

Production of multimedia courses for school related use (for use during teaching or for independent learning directed by teachers) is a relatively new phenomenon. It was started by state institutions and due to the lack of state funding was not developed on a big scale. Only recently did commercial companies become interested in materials development of this kind.

The development of such electronic learning materials (ELM) was not financed from the federal level for a long time. On the contrary, for example, 92 projects of e-learning materials development implemented by higher education institutions got relatively significant funding of R33.3 million only in the year 2000.

Today, there are about 70 titles of CD with relevant educational resources supporting about 10 percent of Russian general school curriculum. At the same time in Holland e-learning materials are integrated in every subject of general school.

In initial vocational education there are no e-learning materials recommended by the Ministry of Education for use in IV schools.

The attempt to make a comprehensive analysis for schools oriented e-learning materials was done by group experts in the framework of Education Innovation Project in 2001. As the result of analysis the situation with products currently in Russian general schools was defined and 21 multimedia products were recommended for forming school media library. Table A4.6 shows the present total in use in Russian schools.
### Table A4.6 Multimedia Products Actively Used in Russian General Schools

<table>
<thead>
<tr>
<th>School subject</th>
<th>Number of products used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Geography</td>
<td>3</td>
</tr>
<tr>
<td>Informatics</td>
<td>3</td>
</tr>
<tr>
<td>Algebra</td>
<td>2</td>
</tr>
<tr>
<td>Biology</td>
<td>2</td>
</tr>
<tr>
<td>Culture</td>
<td>2</td>
</tr>
<tr>
<td>Geometry</td>
<td>2</td>
</tr>
<tr>
<td>Russian language</td>
<td>2</td>
</tr>
<tr>
<td>Foreign languages</td>
<td>1</td>
</tr>
<tr>
<td>History</td>
<td>1</td>
</tr>
<tr>
<td>Technology</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>

*Source:* Analysis of the Russian market of electronic publications on compact discs of educational, encyclopaedic, reference and cultural character, development of a recommendation list for forming school media-library, development of recommendations for creating new sets of electronic publications, Moscow, National Training Foundation, 2001

### Internet Resources

According recent studies Russian education Internet is growing. The number of education related WEB-sites grew by nine times in last two years (Russia E-readiness and e-needs assessment, 2001). However these sites are mainly sites of educational institutions and do not contain learning resources. Most of these sites are very static. Using H.Arsham’s words Russian education Internet “is a graveyard of Web sites who tried but failed to keep up with the contents that the visitors really need from them” (H. Arsham, Impact of Internet on teaching and learning, <http://ubmail.ubalt.edu/~harsham/interactive.htm> 2000).

*Examples of Internet learning resources for schools:* The website *Astronomia na pen’ke* includes relevant materials developed by the staff of major higher education institutions, which though they are undoubtedly interesting to the people enthusiastic about astronomy, they do not fully correspond to the school discipline. Materials of such sites interpret subject content in a fragmentary manner and theme interpretation clearly reflects author's opinions or personal pedagogic experience.

*Physicon* corporation operates in cooperation with highly paid specialists in respective subject areas. Its site includes materials covering several courses of school pedagogics. However, correlation between the content of such sites and standard state requirements with regard to relevant disciplines is difficult.

Some site designers make annotations of educational Internet resources. For instance, each subject section of the site of network methodological divisions of the Internet Education Federation Center includes a list of resources that might be useful for the educational process in
general education schools. Thus, as of August 15, 2002, physics section contained annotation of 27 resources, history section 189, mathematics section 110, etc. Furthermore, some portion of the site electronic resources contains not only annotations but also detailed methodological recommendations concerning their use in dealing with individual themes of the curricula.

HUMAN RESOURCES FOR INTRODUCTION OF ICT IN EDUCATION

Preservice Teacher Training

Only 20 percent of schools have ICT specialists within the staff. However the situation is changing because almost all state teacher training institutions opened courses to train teachers of ICT. There were 93.8 thousand graduates from pedagogical higher education institutions in 2000. (See table A4.7)

Table A4.7 Information about State Preservice Teacher Training Institutions

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number of institutions</th>
<th>Number of students (people)</th>
<th>Admission (people)</th>
<th>Graduates (people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State pedagogical secondary vocational educational institutions</td>
<td>636</td>
<td>263,176</td>
<td>87,751</td>
<td>71,037</td>
</tr>
<tr>
<td>State pedagogical higher educational institutions</td>
<td>158</td>
<td>619,324</td>
<td>166,141</td>
<td>93,081</td>
</tr>
</tbody>
</table>


There were 1,292 vacancies for informatics teacher in Russia in 2001 while the number of students of state pedagogical higher educational institutions graduating with the profession of informatics teacher in 2002 was 598.

Many educational institutions of different levels have a position of deputy head for education informatization but until now these employees have had no relevant training. Recently two new training programs were approved in 1) PhD in the field of education informatization and 2) higher education graduate degree in management of education informatization.

In-Service Teacher Training

Older teachers do not want to master the new technologies now being demanded; but younger teachers just do not come to Russian schools. (Official statistics from 1989 on showing the average age of teachers are not available, but it can be estimated as forty-five years with an average length of service of sixteen years).

There is at least one state in-service teacher training institution in every region of Russia and all of them provide training in the field of ICT. More than sixty private organizations provide in-service teacher training in the field of ICT (the most active are Federation of Internet Education, Intel Teach for the Future, ORT).

ICT As a Part of Vocational Training
According to the Ministry of Education, about 25 occupations from the standard list of occupations require ICT skill development. About 50 percent of the total number of IVE schools provide training in such occupations. Figure A4.1 (below) shows the extent of computer literacy among IVE students. Curriculum guidelines for all 293 occupations from the Ministry of Education list include ICT as a separate subject.

**Figure A4.1 Computer Literacy of IVE Students (49,000 Students Surveyed in 50 Russian Regions), 2001–2002**

Examples of projects and programs given here provide scope for both teachers and students. **Telecommunication Projects for Students**

Many telecommunication projects (TP) involving students from different schools were launched last year in Russia. Several hundred web-servers provide TPs in Russian (according to www search engines). Many, supported by Western grants, showed great effectiveness. Examples of such projects are Kidnet for the exchange of geography data and Global Education for the exchange of school ethnography projects. However, with the end of external support many TPs did soon cease to fulfill their potential. Only a few TPs are supported at the Russian federal or regional level. The most successful and impressive examples of TPs are presented below. Their experience shows that students and teachers from rural and remote (if they have an access to telecommunication channels) are the most active participants of TPs.

**Examples of Best Telecommunication Projects.** Some examples are as follows:
• **Russian branch of the international project I*EARN** <http://www.iearn.org>. Almost 7,000 Russian students are involved in diverse telecommunication projects in the framework of this program. Most of participating students are from Russian regions (not from Moscow).

• **Project SEED Schlemberger** http://www.slb.com/seed/index_ru.htm. This is a scientific laboratory for students. Its pages contain information (in Russian) related to discoveries in natural sciences, out-of-the-ordinary experiments, curious events, and men of science. Students involved in experiment-based activities in the framework of this project are conducting research and laboratory studies.

• **Russian Child Internet Festival Umnik** (Krasnoyarsk http://www.childfest.ru/). The festival includes the whole array of project tasks for children. The tasks are published on the site and e-mailed to all participants (by subscription). The projects may be developed in the following areas: sociological, ecological, technical, cultural, historical, civil-patriotic, etc. Participants in the festival include school-age pupils and higher education students as consultants organized in teams. Nearly twenty projects were implemented during the 2001–2002 academic year. In all, about 7,000 students took part in the festival.

• **Projects of the Center for Telecommunications and Information Systems in Education in Yaroslavl.** Annually, over 12,000 students from all Russian regions are involved in the center-based Internet projects in ecology, health, and different intersubject areas.

• **Festival of intellectual games Zeleny shum** <http://schools.keldysh.ru/avt096887/fest.htm>. This is an international festival; it has two forms, that is, full-time studies and studies by correspondence. Tasks designed for the studies by correspondence are published in popular-science journals and popular monthly editions as well as on the following two Internet sites: <http://school.keldysh.ru/avt096887/festival.htm> and <http://www.chgk.msk.ru>.

**General Distance Education Programs**

*Examples of general distance education programs.* The following ten examples are sponsored from different parts of Russia including Moscow.

• **Moscow State University correspondence school** is an institution of a supplementary education; high-school students’ studies are based on in-depth programs. The school has no Internet, all contacts with the students are arranged by post. A similar correspondence school at the Moscow Physical Engineering Institute is also a supplementary education institution. Annually, about 12,000 students make their studies there. About 50 percent of them are evening course students, the rest of them study by correspondence. An absolute majority of correspondence students make use of conventional post services. However, there are some students who have an opportunity to use the e-mail: prior to 2002, two percent of students used the e-mail, while last year their number increased several times.

• **The project Teleschool (Teleshkola)** initiated by the Ministry of Education <http://www.teleschool.ru/> represents a distance education system on the educational TV basis that has two forms: external studies and supplementary studies. The form of external studies provides an opportunity for learning in grades 10 and 11 of secondary school and getting the State Certificate of General Education of a Moscow educational...
The form of a supplementary education makes it possible for subscribers to educational TV to receive relevant educational information through satellite digital TV channels. As an organization, Teleshkola is an educational institution that arranges methodological and technical aspects of the distance learning process on the educational TV basis providing an opportunity for making external or supplementary studies. The work with students in the framework of the project is on a fee-for-education basis.

- Private software development company Kirill and Mephodii (K&M) has a number of general education courses in electronic form. The company launched in Internet a free project Virtual School of K&M. Virtual School (VS) is an interactive educational portal of K&M and it is an analogue of general school in Internet (http://vschool.km.ru/). Virtual School combines a systematic methodological approach to presenting learning material with new ICT. The school is open for everybody and free of charge. It provides lessons in algebra (grade 7, 8), geometry (grade 7–11), Russian language (grade 5, 6), physics (grade 5–11). One can use it as a source of help in learning or teaching new material, in filling gaps in in-class education or in getting distance general school education by independently. However, graduation from the VS does not give a general school diploma and is not recognized by authorities. The VS portal has special sections for students, teachers, parents, and administrators. The VS lessons contain some interactive parts (usually they are interactive tests). The Virtual School is available online and on CD. The VS on CD base was supplied to Moscow schools. Therefore there is no regular feedback to K&M company from those schools about the effectiveness of the VS operating within framework of regular schools. Another weak point is that the VS program quite often is unknown to regional organizations implementing distance education programs in the field of general education.

- Physicon company http://www.college.ru/. This company provides distance support for the independent study of the school curriculum. Its web site is interactive and has a large number of multimedia illustrative materials, which gives students an opportunity to check their knowledge and see test results but does not envisage any system of education or tutorship. Students can study the following subjects on their own: economics, physics, plane geometry, solid geometry, chemistry, astronomy, and biology. No certification of education is provided.

- Distance education center Eidos http://www.eidos.techno.ru/. This center provides learning based on subjects that mainly are not basic school disciplines, they rather belong to the supplementary education. The course Creative English, a primary school course to be studied with the help of the adults called Numbers, and a humanitarian course for the students of grades 5 to 9 – Mirovedenie (World Geography and History) – may be taken as examples of such courses.

- Basic activities of the Yaroslavl Center of Telecommunication and Distant Technologies http://www.edu.yar.ru/russian/netweb.html. These activities include the implementation of projects and olympiads. Project participant proactive involvement in these forms of educational activities is very high: up to 12,000 school students annually. At the same time, the support of the teaching activity is far less adequate. The materials placed in Academic Curricula sites are noninteractive text files and almost all date back as far as 1995–1996. According to unofficial sources, currently, the Yaroslavl center has a positive experience in terms of distance learning of a handicapped child in computer web design. In 2002/2003, it plans to educate 30 handicapped children.
• **Moscow Center of Internet Education** [http://center.fio.ru/do]. Since April 2002, an experimental Internet class for developing a distance education system that includes several general school subjects has been conducted, with the support of the Moscow Center of Internet Education. At the first stage, sixty-seven students of grades 5 to 11 from five Moscow schools were involved in the experiment. The whole range of pedagogical, methodological, and technical issues is being reviewed in the course of the experiment. At the second stage, it is planned to consider opportunities for arranging a practicable educational process for students from diverse regions. The project is to be completed by December 2003.

• **Open Russian School (ORS).** To satisfy educational demand of Russian speaking students living abroad, a nonstate noncommercial educational institution, Open Russian School (ORS), was set up in December 2001. For compatriots living on a permanent basis in the CIS and Baltic countries as well as in other countries, ORS provides distance education in accordance with educational standards of the Russian general secondary school education. Education in ORS is provided in a distance form, training is catered with use of specially developed information and educational technologies on the basis of the educational internet-resource www.vetka.ru. The www.vetka.ru resource functions as an interactive system that includes a complex of special programs allowing fast information exchange between a student and teacher, as well as an opportunity for control of the educational process by parents and teachers. To facilitate internet access and cut the relevant expenses, each student is provided with a personal CD-disk that contains all the tests as well as all the necessary textbooks, study and didactic materials, and libraries of origin. Upon completion of studies, a student gains access to an intermediate examination to confirm his level of knowledge of educational programs of the Russian general education. This is needed for access to the state examination, which accords a state standard certificate of secondary general education to students who pass. In 2002 a limited number of children have successfully done their studies at ORS.

**Curricula for ICT in schools**

Table A4.8 lists electronic learning materials recommended for school media libraries. These can be drawn on to illustrate data management processes incorporated in the curriculum requirements listed beneath.

<table>
<thead>
<tr>
<th>No</th>
<th>Product</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Algebra: grades 7–11</td>
<td>KUDITS</td>
</tr>
<tr>
<td>2</td>
<td>Living Mathematics*</td>
<td>INT</td>
</tr>
<tr>
<td>3</td>
<td>Open Physics, Parts 1, 2 (2 CD)</td>
<td>Physicon</td>
</tr>
<tr>
<td>4</td>
<td>Living Physics* (Mechanics, Electrodynamics)</td>
<td>INT</td>
</tr>
<tr>
<td>5</td>
<td>General and Inorganic Chemistry</td>
<td>MarGTU</td>
</tr>
<tr>
<td>6</td>
<td>Biology</td>
<td>IC Repetitor</td>
</tr>
<tr>
<td>7</td>
<td>Geography 6th form</td>
<td>RMTS</td>
</tr>
<tr>
<td>8</td>
<td>Geography 7th form</td>
<td>RMTS</td>
</tr>
<tr>
<td>9</td>
<td>History of Russia (9th-11th forms)</td>
<td>Klio-soft</td>
</tr>
<tr>
<td>10</td>
<td>Encyclopaedia of Russian History (862-1917)</td>
<td>New Disc</td>
</tr>
<tr>
<td>11</td>
<td>From Kremlin to Reichstag</td>
<td>RMTS</td>
</tr>
<tr>
<td>12</td>
<td>Professor Higgins. English without Accent</td>
<td>IstraSoft</td>
</tr>
<tr>
<td>13</td>
<td>Francais d’Or, English Gold</td>
<td>MMTiDO</td>
</tr>
</tbody>
</table>

114
Framework of Required Curriculum in Informatics for Secondary School

The following material has been provided by the Ministry of Education.

- **Data and data processes.** The initial idea of data. Informational activities of man. Data processes: receiving, transmitting, transforming and using data. Unity of data al processes in natural nature, society and technique.

- **Data presentation.** Language as a method of data presentation. Coding. Binary scale of notation. Quantity and units of data. Storing and transmission of data and data carriers.


- **Computer.** Basic computer devices, their functions and mutual relations. The initial idea of software management.


- **Formalization and modeling.** Formal and informal problems. Formalization. Transition from a real problem to a data model.

- **Informational technologies.** Technologies of text and graphics processing (textual and graphical editors).

  - The initial idea of **text** and its processing. Textual editor. Recording and reading files from a disk. Printing.
  


  - **Entering numbers, formulas and texts.** Standard functions. Table structure editing. Table printing. Creating a diagram. Electronic tables’ usage for mathematical problems solving.


• Computer communications. Local and global computer informational nets. Modems, channels and the speed of data transmission. E-mail, notice boards, teleconferences, distributed databases.

• Internet as an example of a global net of telecommunications.

“NON-CONVENTIONAL RESOURCES” – RUSSIAN COMPARATIVE ADVANTAGE

The data demonstrate that Russian education has fallen behind the education systems of developed countries in the area of introduction and integration of ICT. The existing gap can not be eliminated by simply building up the quantity of ICT resources. Thus, in order to achieve the objectives of ICT introduction into teaching and learning the “non-conventional resources” and comparative advantages of Russian education system should be used. The non-conventional resources are the following:

• Financial and substantial support of students’ families and private sector;
• Initiatives and enthusiasm of teachers;
• Initiatives and enthusiasm of students;
• Open source ware;
• Home computers of students and teachers.